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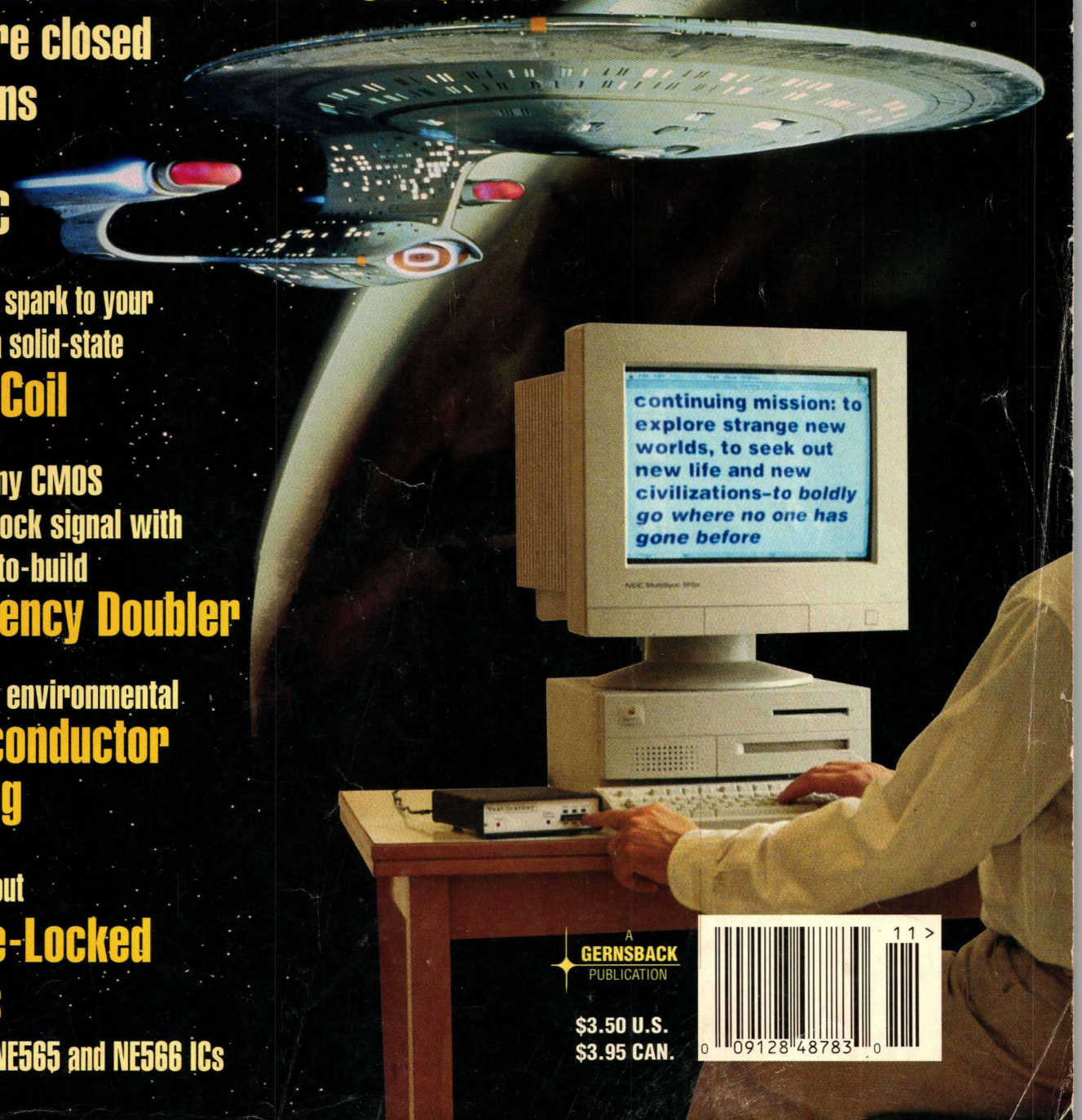
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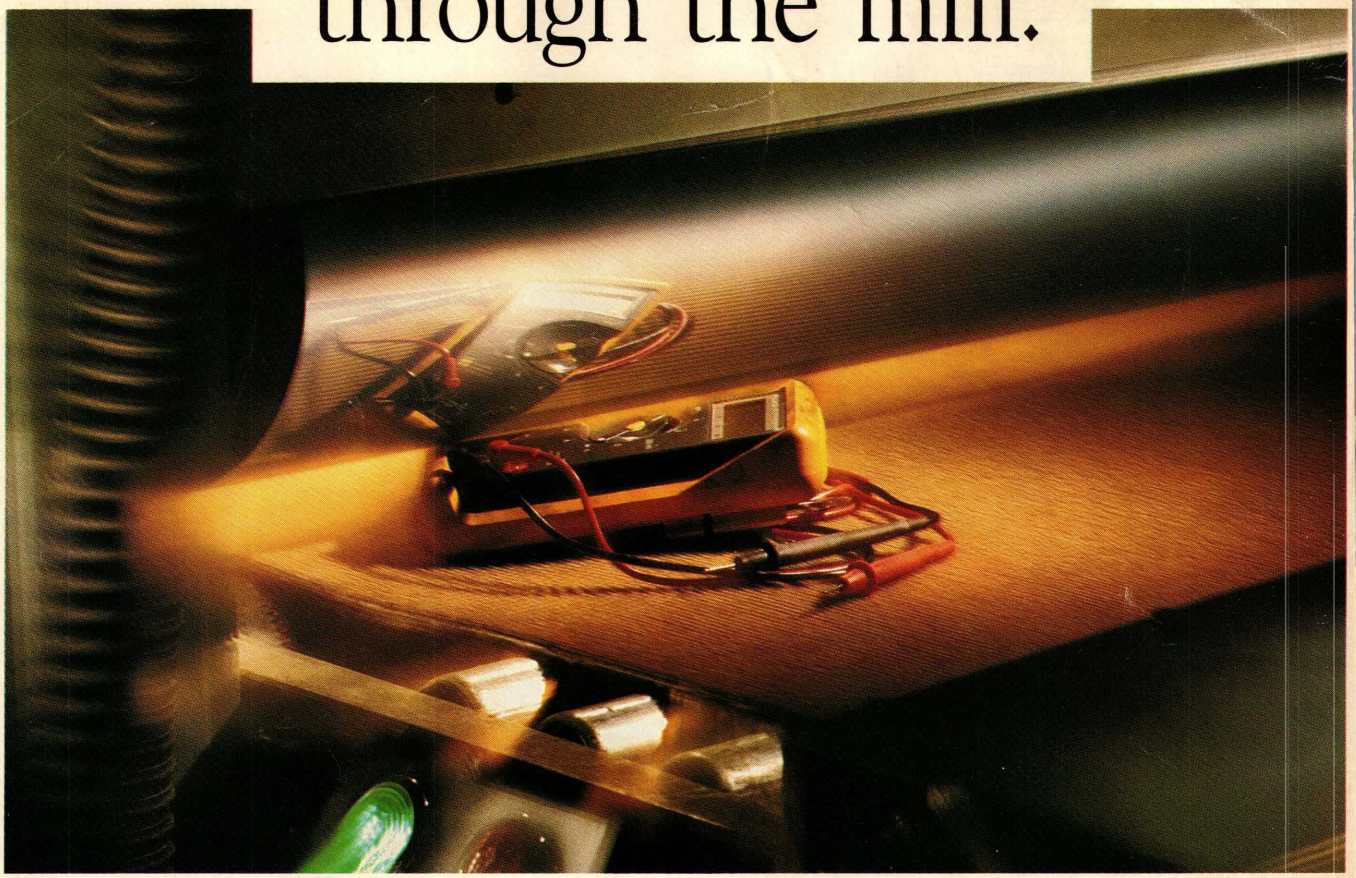

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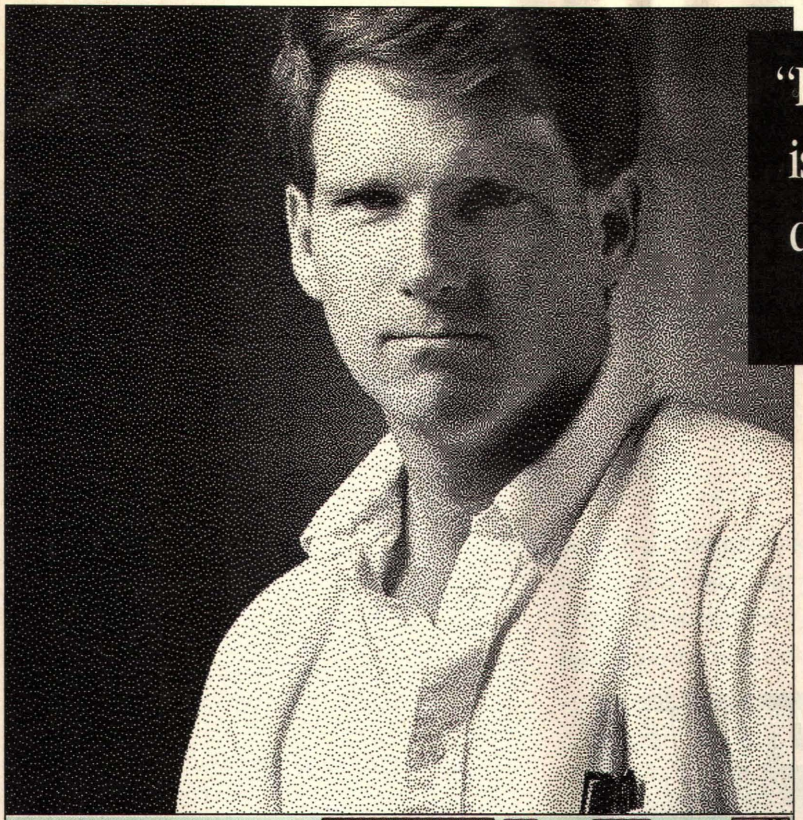

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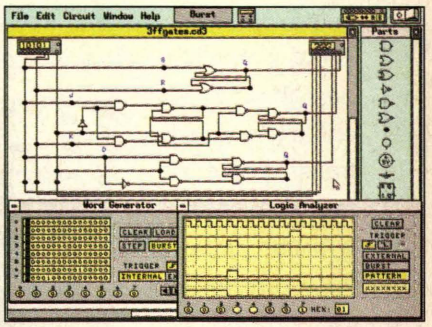

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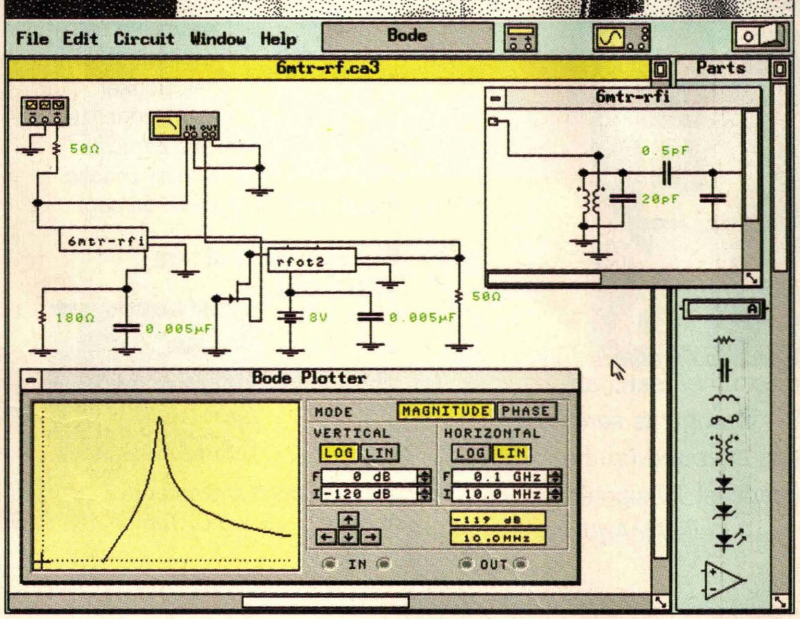

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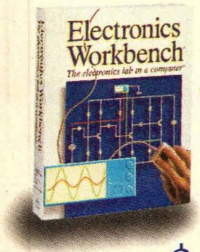

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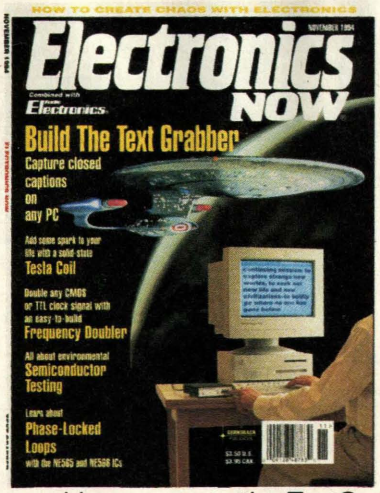
How often do you take the time — and spend the money — to send away for transcripts of television shows? If you're like most people, you don't bother, even if the show is meaningful to you. Now, however, you can bypass the U.S. Mail entirely, and make transcripts of your favorite shows without leaving your home. The TextGrabber lets you capture the complete text of any closed-captioned program, without using a closed-caption decoder. By connecting a video source to the TextGrabber, and the TextGrabber to your PC through its serial port, you can capture the text that is encoded (in the vertical blanking interval) with the broadcast TV signals. — *Kelly McArthur*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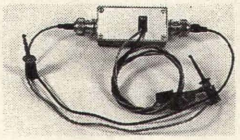

Double the frequency of any CMOS or TTL clock signal with our simple doubler circuit. — *John Yacono*

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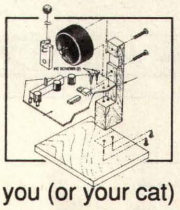

The randomly bouncing ball on the end of the Bonker can hypnotize and captivate you (or your cat) with its chaotic movement. — *Roger Sonntag*

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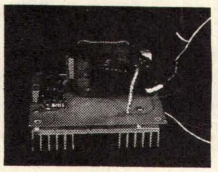

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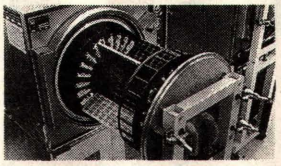

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WHAT'S NEWS

A review of the latest happenings in electronics.

Solar cells by the roll

Research is underway to develop "solar cells in a roll," that resemble rolls of kitchen plastic wrap. When stretched over a frame with wires attached, the thin film will become a solar cell that converts sunlight directly into electricity.

The Advanced Research Development, Inc, (ARDI) of Athol, Massachusetts, and the U. S. Department of Energy's (DOE) Argonne National Laboratory have begun a three-year, $1.8 million research project to develop solar cells that will be made by coating plastic film with photoactive chemicals rather growing layers of N- and P-type semiconductor material.

Thin sheets of a plastic only 1 micrometer thick will be coated with photoactive molecules by a process that is similar to the one for making polarizing film materials. The joint venture researchers plan to apply photoactive molecules developed by the Argonne laboratory onto an electrically conductive, stretchable plastic film similar to polyester developed by ARDI.

Argonne's molecules are based on the perylene dyes similar to those used the photocopying process and in liquid-crystal displays. By themselves, the molecules can convert solar energy into electrical energy with more than 99% efficiency. They will be deposited as a large continuous crystal on the film which can be rolled and cut to meet the customer's requirements. The researchers hope the combination will yield solar cells that are at least 70% efficient.

Sunlight will strike a photoactive molecule, causing positive and negative charges to separate and migrate to electrically conductive strands in the substrate film. Current results when positive charges flow in one direction and negative charges flow in the other way.

Another objective of the project is the development of compatible flexible leads for connecting the film to the electrical load.

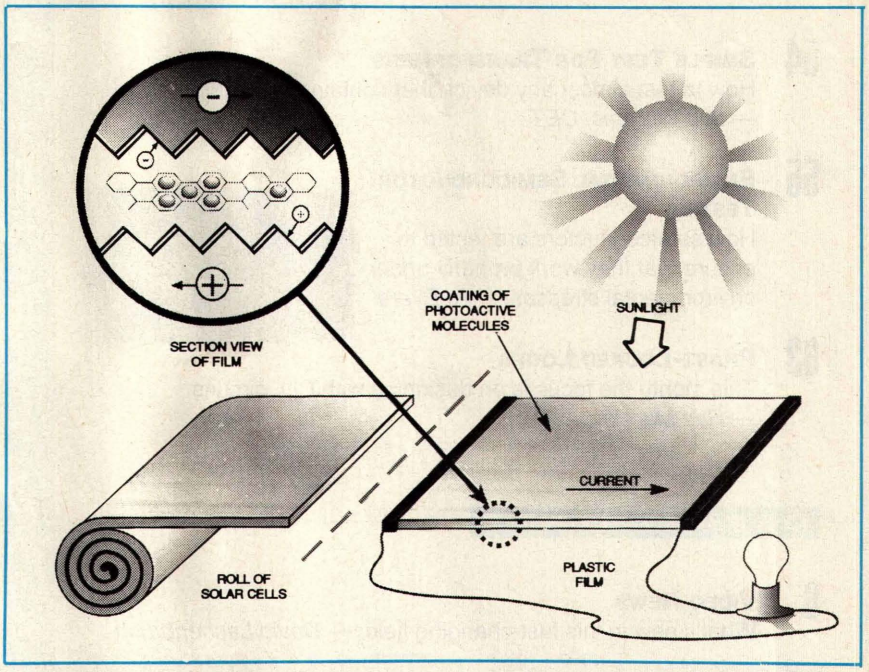

FIG. 1. SUNLIGHT STRIKES PHOTOACTIVE MOLECULES on a thin plastic film causing positive and negative charges to separate and jump to electrically conductive strands in the plastic film. Positive charges flow one way and negative charges flow the other way, causing current to flow.

High-density, three-level gate arrays

A new technology based on novel programming elements and an array of non-dedicated logic gates called a "sea-of-gates" promises low-cost, field-programmable gate arrays (FPGAs). The FPGAs, developed by Xilinx, Inc. of San Jose, California, will be be built with a stacked, three-layer metal-CMOS process.

The substrate for the new device will be a wafer full of unconnected CMOS logic gate elements. This layer will be covered with a second metallic layer containing X-direction rounting wires which is, in turn, covered by a layer of amorphous silicon. A third or top layer will contain the Y-direction routing wires for programming the device.

Antifuses are formed from the amorphous silicon layer sandwiched between the second and third routing wire layers. When the FPGA is programmed, current will pass between selected X and Y wires to form permanent conductive paths that connect the desired logic elements to dedicate the device for a specific application.

According to Xilinx, the combination of these three metal layers will permit the development of FPGAs with many possible routing paths and high gate density in a very small area on the silicon wafer. The process will eliminate the tradeoff now required in making conventional FPGAs: extensive routing capability has meant low gate density, or conversely, high-gate density has restricted routing.

The sea-of-gates (SOG) concept for making FPGAs allows routing wires and programming elements to be stacked above the device's CMOS logic. The concentration of the logic gates in a substrate makes

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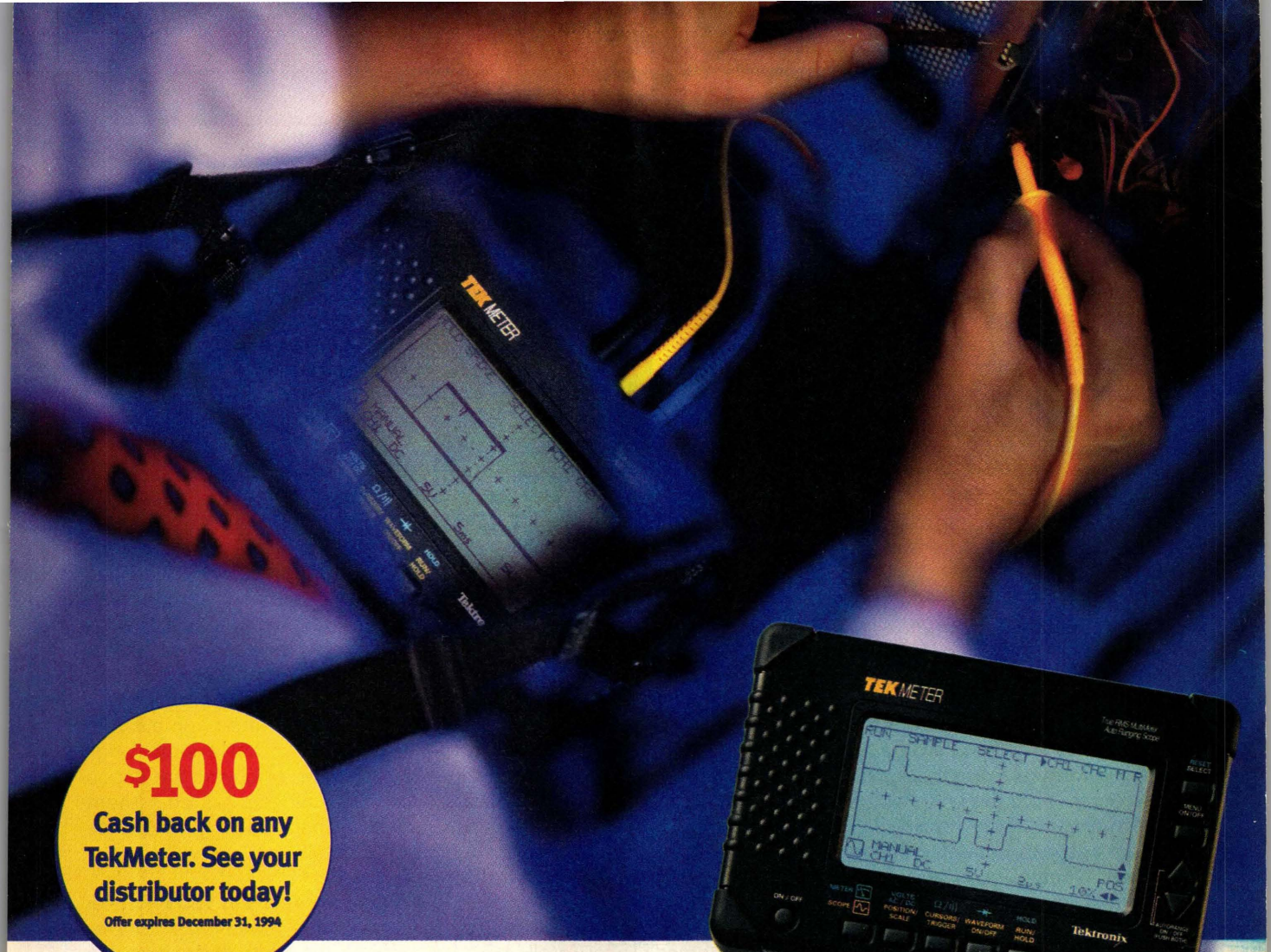

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VIDEO NEWS

What's new in the fast-changing video industry.

DAVID LACHENBRUCH

• **Interactive program guide.** Although there are many different candidates for navigational aids to guide viewers through the intricacies of tuning in the 1000-channel age, it currently appears that the StarSight interactive on-screen guide is far in the lead. The system, developed by StarSight Telecast and now in operation, permits viewers to pick programs from an on-screen grid by title, subject, or type of program. It also lets them switch on the name of the program and episode, along with time remaining, while viewing the program, even during the commercial breaks. As an added attraction, it makes possible VCR recording at the push of a button, merely by selecting the name of the program from the guide.

At our press time, the StarSight system was incorporated into three different types of hardware: Zenith is offering it in eight TV models, it is featured in several Uniden satellite integrated receiver/decoders (IRDs), and it can be found in cable boxes serving Viacom's Castro Valley, California system. Enough of the top television manufacturers have agreed to incorporate it into their future receivers to make it the *de facto* standard.

The latest company to sign a deal with StarSight is Thomson Consumer Electronics, manufacturer of RCA TV sets, the nation's brand. Philips, the number two manufacturer (Magnavox TVs), has also signed up. Both companies will be entitled to sell StarSight sets after a brief exclusive period for Zenith, which happens to rank as the third manufacturer in terms of sales. Mitsubishi, Goldstar, and Samsung are also licensees.

The StarSight data is transmitted in the vertical blanking interval (VBI) of PBS stations and some cable channels, enabling it to reach an estimated 95% of the population. StarSight-equipped TVs seek out the VBI data, no matter which channel they're tuned to. Each set receives the automatic program guide tailored to the individual viewer-subscriber, on the basis of the subscriber's location and reception system (broadcast, cable, or satellite). StarSight costs $3.50 to $4.30 monthly, depending on the length of the contract purchased.

StarSight's ability to tune a VCR depends on its use of an "IR blaster," a cable from the TV set to the video recorder that activates the infrared remote control receiver on the VCR. StarSight-equipped VCRs are also in the works.

• **Small-dish satellite.** Two months after the launch of the United States' first high-powered Ku-band satellite service, receivers and 18-inch dishes were selling as rapidly as they could be built. According to one source close to the scene, viewers in the first markets had purchased nearly 100,000 of the RCA-brand Digital Satellite System (DSS) receivers. The manufacturer said that the receivers will be in short supply until cumulative shipments total 500,000 to 600,000 units later this year.

Two Hughes satellites eventually will broadcast 150 channels, but at press time fewer than half that number were on the air, pending activation of the second bird, which was launched in August. Sales of receivers started late in June in a few selected areas with low cable TV penetration, fanning out to 12 states by August and scheduled to be nationwide by year-end. Of the two receiver models, RCA said that the more expensive $899 unit initially was outselling the $699 model by a two-to-one margin. The cheaper package includes an 18-inch parabolic dish antenna, an integrated receiver/descrambler (IRD), a low noise block downconverter (LNB), and a remote control. The higher priced system adds a dual-output LNB and a universal remote. The company said that a surprisingly large number of buyers are choosing to install the systems themselves rather than pay for professional installation.

Thomson's small-antenna DSS satellite system has been selling faster than the company can ship them out.

• **Widescreen vs. HDTV.** Even as the United States was completing field tests for a digital-high-definition TV system, HDTV was faltering in other parts of the globe. Meanwhile viewers increasingly were becoming attracted to widescreen TV sets without the high-definition feature. In Japan, where analog HDTV has been on the air for three years from satellite transmission, there is talk of scrapping the Hi-Vision system and starting over to develop a digital one (*Electronics Now,* October 1994). But the basic attraction of HDTV—digital or analog—is being debated as well. In the three years of Hi-Vision broadcasting, only 25,000 HDTV sets have been sold. However, in the first five months of 1994 alone, Japanese viewers bought 223,000 widescreen TVs with 16:9 aspect ratio screens—and only 3000 Hi-Vision sets, which cost more than twice as much.

In Europe, too, widescreen TVs are beginning to catch on—particularly in France, where dot of pro-

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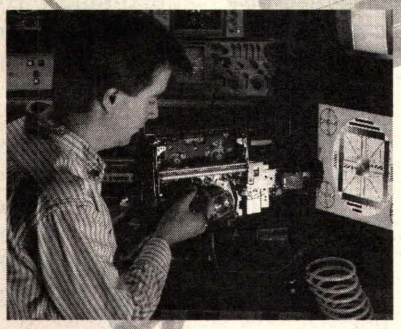

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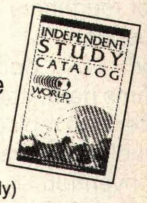

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VINTAGE-GEAR RESTORATION

Gary McClellan's article, "Restore It Right!" (*Electronics Now*, August 1994) was very informative, and his list of sources for components was especially welcome.

Those who restore old electronic gear should be aware of some changes in electronic terminology that have taken place over the years. For example, most of us know that a capacitor was once known as a condenser, but many people might be confused about the values of resistors shown on old schematics.

Circuit diagrams drawn prior to 1930 often specified resistance in "M-ohm," values. However, they are not megohms, as one might initially suspect. "M," the Roman numeral for 1000, denotes thousands of ohms here, not millions. Thus, if you intend to replace a 47 M resistor on an old schematic that followed that convention, it should be replaced with a 47 K resistor, or the circuit will not work.

It's easy to determine if that convention applies in an old schematic diagram by noting the absence of kilohm resistance values; seemingly large-value resistors are located where smaller values would be more appropriate in more modern circuits that perform essentially similar functions.

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Surrey, BC, Canada

NEW, BUT NOT IMPROVED, TELEPHONE RING AMPLIFIER

In the "Letters" column in the August 1994 issue, a schematic for an "improved" telephone ring amplifier was published as Fig. 2 on page 26. That schematic contains a number of errors that should be corrected if the builder wants the circuit to operate correctly and safely.

Most telephone systems have two different voltage levels. First, there is the static voltage that exists on all phone lines when the handset is hung up and not ringing. It is usually 48 volts DC. (Capacitor C4 will eventually charge to this value.) Second, there is a ringing voltage that is impressed on the DC voltage. It is about 110 volts AC at 20 Hz and the instantaneous peaks of this ringing voltage are at about 155 volts.

First changes should be in diode ratings. Diodes D3 and D4 (1N4148s) will "see" the 155 volts peak, plus the 48 volts across C4. This value is considerably higher than the 100-volt rating of the 1N4148s specified in Fig. 2. Therefore, 400 PIV diodes, such as 1N4004s, should be substituted for all four 1N4148 diodes. (Another good reason for having some safety margin here is to protect the circuit against line transients that can occur during electric storms.)

The second correction should be in the value of resistor R4. Capacitor C4 will typically charge to about 48 volts DC from the telephone line. When a ringing signal appears, transistor Q1 will turn on. With Q1 conducting, +48 volts is applied from the plus side of C4 to the left side of R4. That could destroy Q1, R4, or Q2—or possibly all three. This can be prevented if resistor R4 has a value of 10,000 ohms.

The third correction relates to buzzer BZ1. As stated earlier, C4 will charge up to the approximate phone line voltage. With the values of the diodes and resistor R4 changed, a ringing situation could turn on Q2. Transistor Q2, acting like a switch, applies the full voltage of C4 across BZ1.

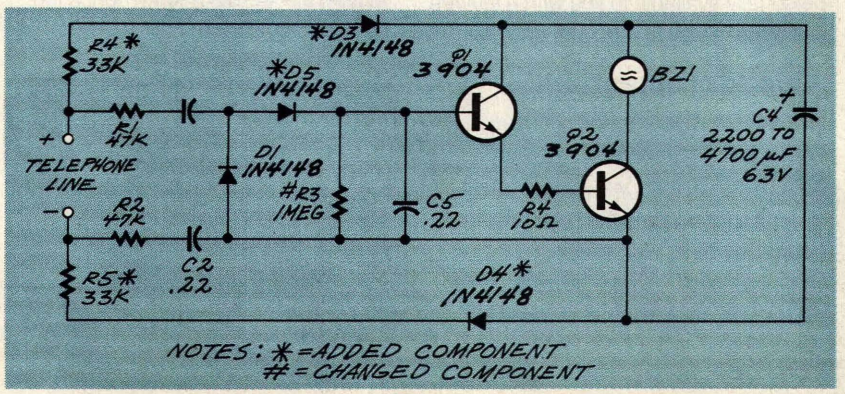
After checking with a number of piezoelectric buzzer vendors, I found that most are rated in the 6- to 16-volt DC range, with the highest rating 28 volts DC. A voltage of 48 volts would destroy most of these buzzers.

A simple fix for this limitation is the placement of a Zener diode in series with the top end of BZ1. The diode will drop the 48 volts down to a safe voltage range for most buzzers. For example, if you want to use a 12-volt buzzer, install a 36-volt Zener diode (or three 12-volt Zener diodes in series). The cathode end of the Zener diodes is directed toward the +48-volt source.

Notice that Fig. 2 does not show the polarity of the buzzer, a serious oversight. The negative side of the buzzer should be directed toward Q2.

Many transistors that are popular with experimenters have maximum voltage ratings of only 40 volts. The transistors in Fig. 2 should have at least a 60-volt maximum rating (because of the 48 volts supplied to the circuit by C4).

The only other comment I'll make is that the circuit builder should be aware of the fact that if the handset remains off hook for long periods,



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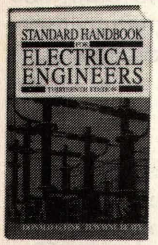

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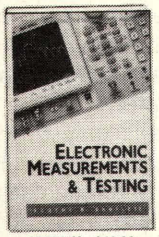

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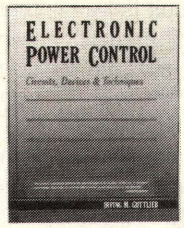

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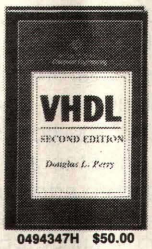

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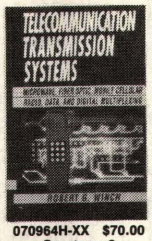

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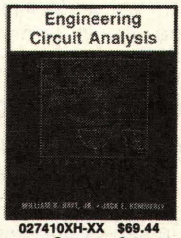

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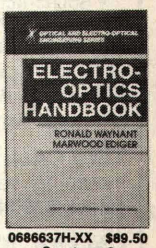

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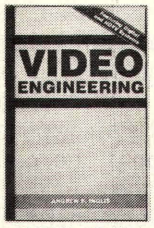

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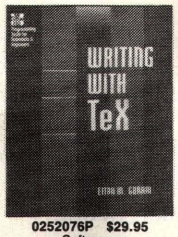

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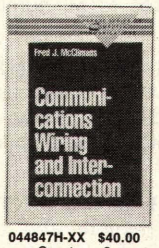

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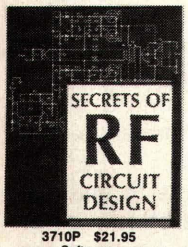

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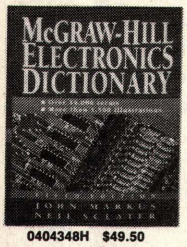

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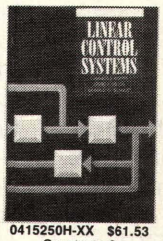

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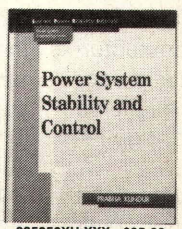

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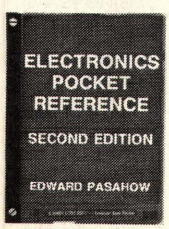

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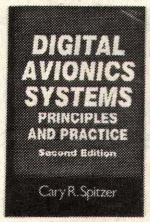

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capacitor C4 will self-discharge. Its discharge rate will depend on its internal leakage and the phone line voltage. In an off-hook situation, that could be from 5 to 30 volts.

When the handset is restored to the on-hook condition, C4 will recharge. That is also something to keep in mind when the circuit is installed. The capacitor charges through resistors R4 and R5 and their combined time constant with C4 is about 310 seconds! So allow at least 15 minutes after installing the circuit before attempting to use it or it will not work properly.

DONALD G. CHESSIER
Garland, TX

ADDRESS AND PRICE UPDATE

Thank you for featuring Progressive Concepts' MasterSwitch in "New Products" in the July issue of *Electronics Now*. However, since we sent you the information about the MasterSwitch, the company has moved and the price has changed.

The new address is: Progressive Concepts, 1424 North Mills Avenue, Claremont, CA 91711. Fortunately, our phone number is still the same: 909-626-4969.

The MasterSwitch now costs $36 in kit form and $46 fully assembled.

ERIC HOPPE
Claremont, CA

CHANGING TONER CARTRIDGES

I am writing to comment on the "Hardware Hacker" column (*Electronics Now*, August 1994) in which the refilling of the Canon-EX toner cartridge was discussed. The article describes briefly the remanufacturing of this cartridge for the end user and also for people who might be interested in starting a cartridge-recycling business.

The instructions and illustrations are too simplistic and do not cover the total inspection and cleaning procedure that a competent remanufacturer will use to produce a superior product.

Those who follow the two refilling methods described in the column are asking for trouble every time they put the cartridges in their printers. Cartridges that spill toner from the toner collection bin will scatter toner over the interior of the machine. This could jam the main drive train which in turn can break gears and clutches, and even ruin fusing rollers.

The rotating blade of the toner collection bin is rotated by the drive train of the cartridge. The rotation of the blade can be restricted by overfilling the bin. Under certain conditions the blade might be stopped completely.

That is only one of many problems that can be caused by an improperly remanufactured cartridge. There are a lot of other potential problems related to remanufacturing. For example, many manufacturers and distributors of remanufacturing supplies require a minimum purchase of at least $50. That is a high price for the consumer of only one cartridge every six months.

Consumers must also contend with the deterioration of the *organic* compounds in the drum and toner. Those products have a finite useful life. If they are exposed to the environment for too long a period, their degraded performance could result in poor prints.

Anyone who wants to enter the recycling business should extensively research the products they intend to remanufacture. The production of quality remanufactured toner cartridges requires an understanding of how each type of cartridge should function normally.

I have seen many cartridges that worked well for the first 100 test pages but started to print poorly after that. You should be aware of the problems that might occur and the corrective action that must be taken before a single cartridge is shipped. You won't be in business long if your customers are your test subjects.

Be prepared to compete! There are many remanufacturers with excellent reputations in business with high-powered sales forces. If you enter the market with a poorly conceived sales plan and an even poorer quality remanufactured cartridge, you will not be there for long. Customer service, informative advertising, and a quality product at the right price will keep you going.

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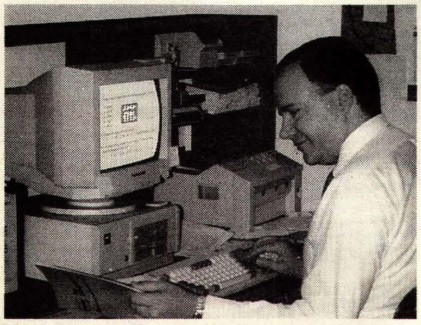

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remanufacturers have expanded their companies to provide printer, computer, copier, and fax machine sales and service. The prices of remanufactured cartridges no longer provide profit margins that are high enough to cover overhead.

Summing up, the consumer should seek out a quality cartridge remanufacturer. Most good ones will either let you try one of their cartridges before you buy it, or offer a written money-back guarantee. It's not really worth the time and money spent in repairing an expensive printer—not to mention the aggravation—just to get your per-page costs down close to zero.

KEVIN D. BUSTO
Toner Cartridge Services, Inc.
Richville, OH 44706

MORE ON TONER CARTRIDGES

I am writing to call your attention to some of the *facts* about toner refilling that appeared in *Q&A* in the May 1994 *Electronics Now*.

As a remanufacturer of laser-printer toner cartridges since 1985, and a recycler since 1978, my firm, Mag Tech, produces more than 2000 cartridges per month. Each cartridge works as well as a new one. Our customers are satisfied with the remanufactured units. Some last as long as eight years! Moreover, the remanufacture of cartridges prevents thousands of them from ending up in the nation's already overflowing landfills.

In my opinion, a properly remanufactured toner cartridge will work as well as a new one—perhaps even better. Service personnel from Hewlett-Packard, Apple, and Canon might argue that statement, but they sell new toner cartridges and don't want to be bothered with remanufactured ones.

It's true that some poor quality "refillers," have given the entire industry a bad reputation. Out of the estimated 8000 firms now recycling laser toner cartridges in the U.S., approximately 800 are considered by those of us in the industry to be experts. Those companies know what they are doing, and offer high-quality products and service.

Q&A obviously had a bad experience with one of the 7200 others. It bothers me to hear that, but this only encourages me to renew my efforts to publicize the existence of the expert companies.

Q&A made an excellent point in his answer: "See what they offer as a guarantee, before you sign up, because the cost of repairing a laser printer is substantially more than the savings you will get on the toner cartridge." If everyone followed that good advice, my company alone might be selling 10,000 remanufactured cartridges a month rather than 2000!

MICHAEL W. JOHNSON
Magnetic Technologies, Inc.
Hempstead, NY

Continued on page 29

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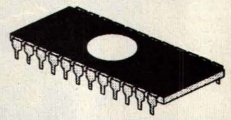

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EQUIPMENT REPORTS

Jameco Electronics JE725 Digital Clock Kit

Build a kit that you'll use every day!

CIRCLE 15 ON FREE INFORMATION CARD

Over the years *Electronics Now* has presented many different clock projects and described various clock technologies—everything from clocks with Nixie-tube displays to clocks that receive WWV broadcasts and provide accuracy approaching that of an atomic clock. Microprocessor-driven clocks have been popular, and clocks that display time in binary numbers provide a fun diversion.

Building an electronic clock from scratch can be a rewarding and educational experience. However, unless you have the mechanical skills and tools to do a professional job, building one from a complete kit will result in a clock that has a better fit and finish.

Clocks are great construction projects because clocks are always useful. Many of the projects built from this magazine are used only sporadically and end up being tucked away the rest of the time. But a working clock—especially one you build—will always be displayed prominently.

When we heard about the new JE725 digital clock kit from Jameco Electronics, we were anxious to build one. (Jameco Electronic Components/Computer Products, 1355 Shoreway Road, Belmont, CA 94002-4100, 415-592-8097, 800-831-4242.) The clock has six 2½-inch high display digits and the double-sided PC board measures a whopping 17½ × 3½ inches. This means the clock is large enough to be seen from up to 50 feet away. The clock can be set to operate in either the 12- or 24-hour mode, has fast and slow time-setting switches, and also has a hold switch to synchronize its display with another clock. The 183-piece kit for building this unique clock sells for $69.95.

A single IC, a National Semiconductor MM5314N, is dedicated to time-keeping and keeps the clock's circuit simple, completely reliable, and very accurate. Most of the circuitry in the kit is for driving the large display, not for timekeeping. The display consists of the six 2½-inch tall digits made up from 126 individual LEDs. (Each digit is essentially a seven-segment display and each segment includes three discrete LEDs.) The display is unusually attractive and eye-catching.

The finished clock board is attractive enough to be displayed by itself, but two optional enclosures are also available: a semi-open enclosure reveals much of the PC board, and an extruded aluminum enclosure hides the board completely. Each enclosure has a red plastic filter to make the display more visible. Both enclosures are priced at $29.95. We opted for the sleek black-anodized extruded aluminum enclosure that measures 18½ inches wide—it really looks great.

Discounts are available on orders of 10 or more clocks, which might make the JE725 attractive as a project for an electronics class. In addition, for people who want a good-looking clock but who don't trust their electronics assembly skills, it's also available completely assembled. Mounted in the semi-open enclosure the price is $139.95; totally enclosed, the price is $149.95. We believe that everyone who regularly reads *Electronics Now* will want to build the clock, so let's see what's involved in building it.

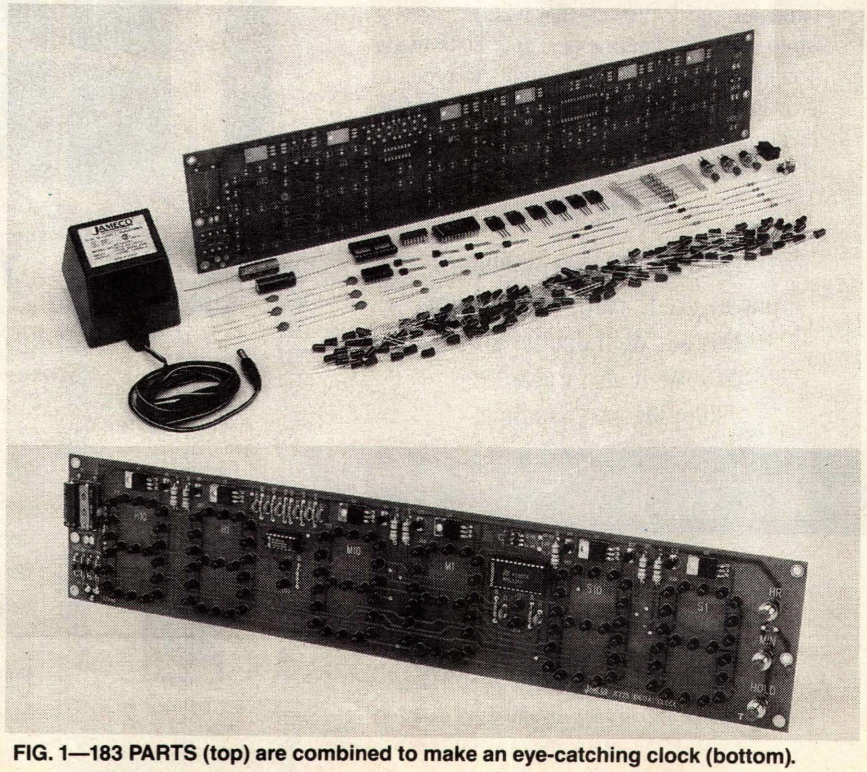

FIG. 1—183 PARTS (top) are combined to make an eye-catching clock (bottom).

Assembling the kit

The clock can be built in one evening, but the job shouldn't be rushed if you want to end up with a neat-looking timepiece. All components, including 126 LEDs, are mounted on the single printed-circuit board. No components are taller than the LEDs, so that the flat plastic filter can lie flush across the entire board.

The display is multiplexed to conserve drive circuitry. Thirteen transistors—six power and seven general-purpose—drive the six digits. Power is supplied sequentially to each of the six digits. When power is applied to a digit, the seven smaller transistors enable the appropriate segments for the intended digit.

One power transistor supplies power to each 21-LED digit. A power transistor is required because up to 21 LEDs can draw current at one time. General-purpose transistors are sufficient for strobing power to the segments.

The most time-consuming task in building the kit is mounting the LEDs. Although the LEDs mount flush with the board, it's very easy to solder them slightly out of alignment, no matter what you do to hold them in place. The assembly instructions recommend tack-soldering one lead of each LED while the PC board rests face-down on a dry sponge. Then the board is held in one hand, and pressure is applied to each LED while the solder is remelted. The procedure, although time-consuming, is actually easy to do and results in a professionally manufactured appearance.

Power is supplied to the clock from a wall outlet-mounted AC to DC power adapter, so no dangerous AC voltages are present on PC board. This provides a hazard-free kit that is ideal for beginners. However, beginners might be intimidated by the large number of LEDs. For kit-building beginners and veterans alike, observing the polarity when installing the 126 LEDs requires double- and triple-checking.

Finishing touches

The finished board can be installed in the aluminum enclosure, a four-piece frame with corner mounting hardware that makes assembly a breeze. The assembled frame is perfectly square and quite sturdy. A plastic backplate (part of the optional enclosure) mounts on the back of the PC board with screws and nuts. Cutouts on the backplate allow access to the 12/24 hour switch, the power jack, and the time-set and -hold buttons. The board and the red plastic filter slide into a partially assembled three-piece frame; the fourth piece holds the board and lens in place.

Four rubber feet mount on the bottom corners of the frame so that it can lie flat and securely on a desk or coffee table. The frame can also be hung on a wall so the clock can be seen by just a few people in your home or by hundreds of people in a large factory. The clock really is quite handsome—even to a spouse who has no interest in electronics. Ω

Cash rebates on Tektronix DMMs.

Tektronix already offers the best value in hand-held measurement tools. Our powerful DMMs normally sell for $67 to $235.* And our new TekMeter™ true RMS multimeter and autoranging scope is regularly priced from $875 to $1285.* But now for a limited time, you can get cash back on the entire TekTools™ family—you'll save up to $100 per unit! This rebate applies for up to 25 units per company, so you can really multiply your savings.

Don't miss this unprecedented opportunity to acquire genuine Tektronix products. Just read the fine print for details and call your nearest authorized Tektronix distributor. For the name of the dealer nearest you, call **800-426-2200**. (When prompted, press 3 and ask for program 300.)

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Company _____

Address _____

City _____ **State** _____ **Zip** _____

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Purchased From _____

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Tektronix

DPW-284598-1 EN

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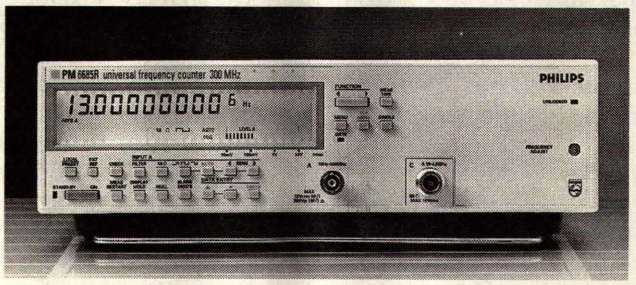
CIRCLE 192 ON FREE INFORMATION CARD

NEW PRODUCTS

Use the Free Information Card for more details on these products.

RUBIDIUM TIMEBASE FREQUENCY COUNTER. The Fluke PM 6685R rubidium timebase frequency counter is the latest of a series of portable frequency counter/calibrators. It offers a 2.5×10^{-10} relative measuring solution. Warm-up time is six minutes to reach 1×10^{-9} and it takes 30 minutes to reach 1×10^{-10}.



CIRCLE 20 ON FREE INFORMATION CARD

This portable, "connect-and-go" frequency calibration tool is suitable for both field and bench use. It provides 10 reliable read-out digits in about one second. Aging decay of the counter accuracy is only 5×10^{-11} per month and 5×10^{-10} per year.

The PM6685R has a standard input frequency range of 300 MHz, with options that extend the range up to 1.3, 2.7, or 4.5 GHz. This allows high-frequency digital calibration measurements without the need for synthesizers, mixers, and filters to achieve the required resolution.

To ensure maximum safety and security, the PM 6685R has automatic overload protection on all inputs. The optional RF inputs (up to 4.5 GHz) are PIN-diode protected to withstand input levels in excess of 12 volts RMS.

The PM 6685R rubidium timebase frequency counter is priced at $10,645. Options include a GPIB/IEEE-488.2 serial interface.

Fluke Corporation
P.O. Box 9090
Everett, WA 98206
Phone: 800-44-FLUKE
Fax: 206-356-5116

20-MHz OSCILLOSCOPE. The Model P-3502C 20-MHz, dual-trace oscilloscope from Protek is suitable for measuring resistors, capacitors, coils, Zener diodes, diodes, and other components in and out of a circuit.

CIRCLE 21 ON FREE INFORMATION CARD

Its key features include a six-inch CRT with 2-kilovolt acceleration, a five times magnification for all time and division settings, and five vertical mode selections. It offers a 20-step horizontal sweep speed from 0.5 second per division to 0.2 microsecond per division. The oscilloscope includes an auto/normal switch; in the auto position it allows a free-running sweep mode for fast trace location.

The P-3502C, priced at $440, includes two probes, a power cord, a fuse, and an operating manual.

HC Protek
154 Veterans Drive
Northvale, NJ 07647
Phone: 201-767-7242
Fax: 201-767-7343

PC16C71/PC16C84 PROGRAMMER/DOWNLOADER. The TrueFlight programmer from Parallax for the PIC16C71 and PIC16C84 microcontrollers can become a downloader by adding a ribbon cable and ultraviolet eraser.

The programmer/downloader has an 18-pin low-insertion force socket that will hold either the PIC16C71 or PIC16C84. The device's pins are duplicated on the end of an 18-pin cable, which can be substituted for a PIC microcontroller in a target system.

When TrueFlight needs to program or read the PIC microcontroller, it breaks the connection between the PIC and the target system, accesses the PIC, and then reconnects it to the target. No relay is needed, so its operation is transparent.

CIRCLE 22 ON FREE INFORMATION CARD

If the PIC has been previously programmed, the flash ultraviolet eraser is positioned over the microcontroller in its socket. Before reprogramming a microcontroller, TrueFlight checks to see if it has been erased. If it has not been erased, TrueFlight turns on the eraser and periodically checks the controller. TrueFlight will reprogram the device only when it has been erased.

A cycle time to erase and program a PIC16C71 is about 65 seconds, but it is only nine seconds for the PIC16C84.

A TrueFlight package, including all software and cables, is priced at $299.

Parallax
3805 Atherton Road #102
Rocklin, CA 95765
Phone: 916-624-8333
Fax: 916-624-8003

PORTABLE PC. The Contura Aero portable personal computer from Compaq is said to be 45% lighter and 33% smaller than most notebook PCs. It weighs only 3½ pounds, and it has an outline smaller than an 8½ × 11-inch sheet of typewriter paper.

The Contura Aero has an Intel 486 microprocessor and up to a 250-megabyte hard-disk drive. Its display is a backlit liquid crystal screen. Six hours of operation are possible with an optional, standard-sized rechargeable battery.

Other features include a

Start a money-making career in video/audio servicing!

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NRI's newly expanded training covers all the latest advances in home entertainment electronics, then takes you inside today's high-tech equipment as you learn to troubleshoot, diagnose, and service the complete home entertainment system included in your course: 13" color TV, programmable VCR, and integrated audio rack system. Only NRI makes it so easy to start a new career, earn part-time income, even start a video/audio servicing business of your own!

Billions of dollars of video/audio equipment means big opportunity for you

There's never been a better time to get involved in home entertainment electronics. Experts predict that consumers of video/audio equipment will spend over $26 billion by 1995 as product manufacturers race to fill the demand for increasingly sophisticated technology.

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You start with lessons that give you a strong foundation in electronics fundamentals, mastering the basic circuits and components at the heart of today's video/audio equipment.

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Best of all, you're prepared for the technology of today and tomorrow with hands-on training designed to give you invaluable practical experience.

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Plus, NRI custom-produced videos show you in close-up detail how to test, troubleshoot, and service TVs and VCRs like a pro.

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You need no previous experience in electronics to succeed with NRI. Step by step, you accumulate the knowledge and practical experience that will make you uniquely qualified for today's opportunities in home entertainment electronics.

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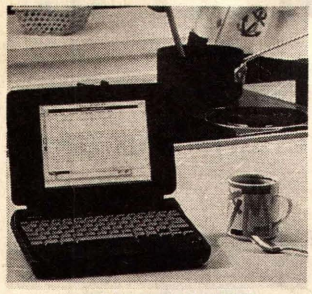


CIRCLE 23 ON FREE INFORMATION CARD

standard keyboard with a palm rest and a built-in trackball, a PCMCIA slot, and a two-prong power cord that fits into any standard electrical outlet. It can be connected to full-size monitors or other keyboards.

Pre-installed software includes DOS 6, Windows 3.1, TabWorks, Lotus Organizer, and WinLink File Transfer software, which allows users to maintain files between the portable and a desktop computer. Consumer models also include Microsoft Works and Microsoft Entertainment Pack.

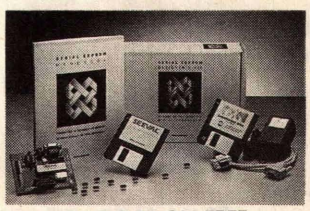
The Contura Aero with a monochrome screen is priced at $1399; with a color screen it is priced at $2199.

Compaq Computer Corp.
P. O. Box 692000
Houston, TX 77269-2000
Phone: 1-800-759-1533

SERIAL EEPROM DESIGNER'S KIT. The Serial EEPROM Designer's Kit from Microchip Technology is intended to help engineers select and design in serial EEPROM nonvolatile memories. It includes all the circuitry, PC-based software tools, and on-line reference materials needed to create, model, integrate, debug, and test systems with serial EEPROMs.

The kit includes the SEEVAL serial EEPROM programming and evaluation system, Total Endurance software tool, the Serial EEPROM Handbook, and assorted support materials.

SEEVAL enables the designer to learn serial EEPROM operational theory and applications, load an EEPROM with known data before a test, modify all or part of an EEPROM array, evaluate the effect of microcontroller code on a serial EEPROM, save or restore data to or from a disk, and program special device features.



CIRCLE 24 ON FREE INFORMATION CARD

Total Endurance allows the designer to model a serial EEPROM within a specific application environment and analyze the effects of density, temperature, voltage, write mode, bytes per cycle, and cycles per day on erase and write endurance.

The handbook is a handy reference source on EEPROMs. It includes Microchip serial EEPROM data sheets, application notes, qualification reports, and other useful EEPROM reference documentation. A power supply, RS232 cable and samples of Microchip serial EEPROMs are included.

The Serial EEPROM Designer's Kit costs $149.

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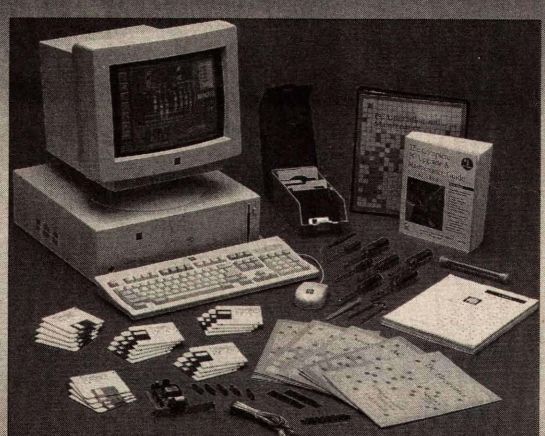

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CIRCLE 86 ON FREE INFORMATION CARD

900 MHz breakthrough!

New technology launches wireless speaker revolution...

Recoton develops breakthrough technology which transmits stereo sound through walls, ceilings and floors up to 150 feet.

Breakthrough wireless speaker design blankets your home with music.

By Charles Anton

If you had to name just one new product "the most innovative of the year," what would you choose? Well, at the recent *International Consumer Electronics Show*, critics gave Recoton's new wireless stereo speaker system the *Design and Engineering Award* for being the "most innovative and outstanding new product."

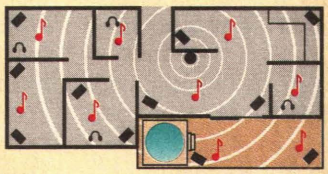
Recoton was able to introduce this whole new generation of powerful wireless speakers due to the advent of 900 MHz technology. This newly approved breakthrough enables Recoton's wireless speakers to rival the sound of expensive wired speakers.

Recently approved technology. In June of 1989, the *Federal Communications Commission* allocated a band of radio frequencies stretching from 902 to 928 MHz for wireless, in-home product applications. Recoton, one of the world's leading wireless speaker manufacturers, took advantage of the FCC ruling by creating and introducing a new speaker system that utilizes the recently approved frequency band to transmit clearer, stronger stereo signals throughout your home.

150 foot range through walls!

Recoton gives you the freedom to listen to music wherever you want. Your music is no longer limited to the room your stereo is in. With the wireless headphones you can listen to your TV, stereo or CD player while you move freely between rooms, exercise or do other activities. And unlike infrared headphones, you don't have to be in a line-of-sight with the transmitter, giving you a full 150 foot range.

The headphones and speakers have their own built-in receiver, so no wires are needed between you and your stereo. One transmitter operates an unlimited number of speakers and headphones.



Recoton's transmitter sends music through walls to wireless speakers over a 75,000 square foot area.

Crisp sound throughout your home. Just imagine being able to listen to your stereo, TV, VCR or CD player in any room of your home without having to run miles of speaker wire. Plus, you'll never have to worry about range because the new 900 MHz technology allows stereo signals to travel over distances of 150 feet or more through walls, ceilings and floors without losing sound quality.

One transmitter, unlimited receivers. The powerful transmitter plugs into a headphone, audio-out or tape-out jack on your stereo or TV component, transmitting music wirelessly to your speakers or headphones. The speakers plug into an outlet. The one transmitter can broadcast to an unlimited number of stereo speakers and headphones. And since each speaker contains its own built in receiver/amplifier, there are no wires running from the stereo to the speakers.

Full dynamic range. The speaker, mounted in a bookshelf-sized acoustically constructed cabinet, provides a two-way bass reflex design for individual bass boost control. Full dynamic range is achieved by the use of a 2" tweeter and 4" woofer. Plus, automatic digital lock-in tuning guarantees optimum reception and eliminates drift. The new technology provides static-free, interference-free sound in virtually any environment. These speakers are also self-amplified; they can't be blown out no matter what your stereo's wattage.

Stereo or hi-fi, you decide. These speakers have the option of either stereo or hi-fi sound. You can use two speakers, one set on right channel and the other on left, for full stereo separation. Or, if you just want an extra speaker in another room, set it on mono and listen to both channels on one speaker. Mono combines both left and right channels for hi-fi sound. This option lets you put a pair of speakers in the den and get full stereo separation or put one speaker in the kitchen and get complete hi-fi sound.

These wireless stereo headphones have a built-in receiver.

Factory direct savings. Our commitment to quality and factory direct pricing allows us to sell more wireless speakers than anyone! For this reason, you can get these speakers far below retail with our 30 day *"Dare to Compare"* money-back guarantee and full one year manufacturer's warranty. For a limited time, the Recoton transmitter is only $69. It will operate an unlimited number of wireless speakers priced at $89 and wireless headphones at $59 each. Your order will be processed in 72 hours and shipped UPS.

Recoton Transmitter (you must have a transmitter to operate speakers and headphones).....**$69** $7 S&H

Wireless products compatible with the Recoton transmitter:

Recoton Wireless Speaker.....**$89** $9 S&H

Recoton Wireless Headphones.....**$69** $6 S&H

Please mention promotional code **165-ET1100.**

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To order by mail send check or money order for the total amount including S&H (VA residents add 4.5% sales tax). Or charge it to your credit card by enclosing your account number and expiration date. Send to:

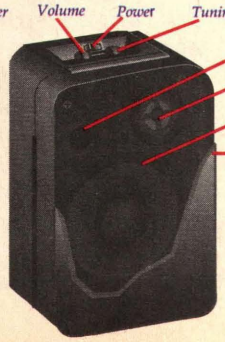
COMTRAD INDUSTRIES

2820 Waterford Lake Drive Suite 106
Midlothian, Virginia 23113

AWARD WINNING WIRELESS SPEAKER

Built-in receiver and amplifier:

The wireless speaker and headphones both contain a built-in receiver and amplifier. Signals are picked up and transmitted as far as 150 feet away through walls without the use of wires.



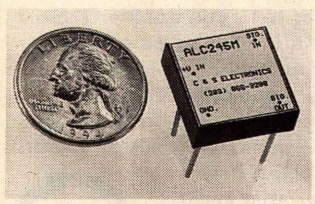
Size: 9"H x 6"W x 5.5"L
Signal-to-noise ratio: 60 dB
Channel Separation: 30 dB
Two-way bass reflex design
10 watts/channel RMS amps
Frequency Response: 50 Hz-15 KHz

Don't take our word for it. Try it yourself. We're so sure you'll love the new award-winning Recoton wireless speaker system that we offer you the **Dare to Compare Speaker Challenge.** Compare Recoton's rich sound quality to that of any $200 wired speaker. If you're not completely convinced that these wireless speakers offer the same outstanding sound quality as wired speakers, simply return them within 30 days for a full "No Questions Asked" refund.

Recoton's Design and Engineering Award

Microchip Technology Inc.
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Phone: 602-786-7200
Fax: 602-899-9210

AUTOMATIC AUDIO LEVEL CONTROLLER. The ALC245M automatic audio-level controller module from C & S Electronics produces a nearly constant output level of 100 millivolts RMS for a wide range of input AC voltages. Any AC signal above the crossover point (unity gain level) is attenuated while any signal below that crossover level is amplified.



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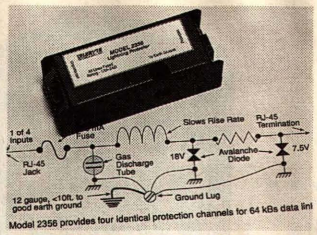
The module, powered from the host equipment, requires 7 to 30 volts DC at 10 milliamperes or less. It is intended for applications in radio transceivers, scanners, and experimental hearing aids.

The single unit price of an ALC245M audio-level controller module is $29.95.

C & S Electronics
P.O. Box 2142
Norwalk, CT 06852-2142
Phone: 203-866-3208

TELECOMMUNICATIONS LIGHTNING PROTECTOR. The Model 2356 lightning protector module from Telebyte Technology protects four-wire (dual twisted pair) telecommunications lines from data error, equipment damage, or personal injury caused by lightning and power surges. It is intended for ISDN networks and telecommunications lines to 64 kilobits.

Four identical stages of



CIRCLE 26 ON FREE INFORMATION CARD

protection are provided for each of four wires. They a fuse, gas-discharge tube, and dual avalanche diodes. The 250-milliampere fuse opens within 500 microseconds to provide communications-link isolation in the presence of surges. It meets the UL1459 requirements for isolation against accidental contact between telecommunications wiring and utility power lines.

The gas-discharge tube can divert a 5000-joule lightning surge to ground. An avalanche diode with a delay circuit clamps spikes that elude the gas-discharge tube to 18 volts. A second avalanche diode clamps the remaining transient energy at 7.5-volts.

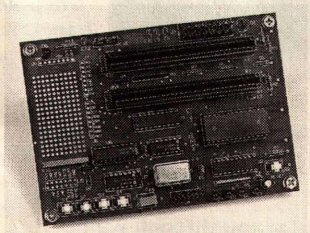
Model 2356 is priced at $97 quantities of less than ten.

Telebyte Technology, Inc.
270 Pulaski Road
Greenlawn, NY 11740
Phone: 1-800-835-3298 or 516-423-3232
Fax: 516-385-8184

PIC MICROCOMPUTER BOARD. The SXT-55 microcontroller board from Unified Microsystems is a single-board microcontroller board for use as an OEM componenent in stand-alone systems. It contains either a PIC16C55 or PIC16C57 microcontroller from Microchip Technology

The input/output capacity of the SXT-55 can be expanded with two IBM PC/XT 8-bit I/O modules. In addition to its two PC bus connectors, the board has user-programmable switches and LEDs, TTL-level input and output lines, and interface circuitry for direct connection to standard liquid-crystal displays.

An open area on the board is reserved for prototype and custom circuitry. Signals inputs are located adjacent to the prototyping area, but they can be taken off the board with ribbon cables.



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The SXT-55 is intended for applications that cannot be adapted to a host personal computer because of cost, size, or power restrictions. It can also serve as a dedicated test platform for PC I/O modules for factory production and field service as well as a portable PC card demonstration unit.

The single unit price of a SXT-55 PIC microcontroller board is $124.95.

Unified Microsystems
P. O. Box 133
Slinger, WI 53086
Phone: 414-644-9036

COMPUTER-MONITOR PATTERN GENERATOR. The Checker 12 from C&M is a handheld, battery-operated pattern generator for servicing computer color-monitors in the field and shop. It permits the isolation of faults in computer monitors to be isolated without opening the monitor enclosure or swapping video cards or monitors.

The Checker 12 supports CGA; EGA; MACII

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640 × 786 sync on green; VGA modes 1, 2, 3, 800 × 600; 1024 × 768 interlaced; 1024 × 768 non-interlaced, and 1024 × 768 non-interlaced with sync on green. The device has been programmed to match the recommended VESA standard for each operating mode.

The Checker 12 provides various test patterns for VGA monitors. The pattern and mode can be selected with a single mode switch. Both size and position can be set. A color-bar/8-step gray-scale pattern allows the evaluation and adjustment of color balance and tracking.

The Checker 12 has a price of $295.

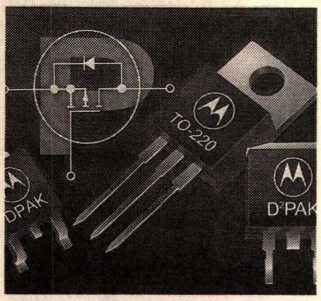
CMM, Inc.
6649-N1 Peachtree Industrial Blvd.
Norcross, GA 30092
Phone/Fax: 404-662-5633

HIGH-CELL-DENSITY P-CHANNEL MOSFETS. *Motorola* has introduced HDTMOS high-cell-density, P-channel, power MOSFETs that exhibit about 50% lower on-resistance than its previous generation of P-channel MOSFET devices.

On-resistance, RD(on), now ranges from 150 megohms to 30 megohms. This makes the devices suitable for applications in which earlier P-channel MOSFETs were inefficient. According to Motorola, lower on-resistance makes the HDTMOS devices an effective alternative to the

N-channel MOSFET switch.

A potential application for the logic-level P-channel devices is in high side switches that can disable or enable an H-bridge motor-drive circuit. Other prospective applications include their use in switching power supplies, motion-control systems, power management circuits for portable computers and peripherals, and in some personal communications products.



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The devices include an improved body diode. HDTMOS devices have a shorter and softer reverse recovery time and less stored charge than previous MOSFETs, so they are said to generate less noise during switching. The first four devices introduced are in DPAK, D²PAK, and TO-220 cases. They are rated 60 or 30 volt $V_{(BR)DSS}$.

Pricing for the MPT50P03HDL (TO-220) package is $2.52 each in volume quantities.

Motorola Inc.—MD Z-311
5005 East McDowell Road
Phoenix, AZ 8501856
Phone: 602-244-3071

SYNTHESIZED FUNCTION GENERATOR. The Model 2003 synthesized function generator from Global Specialties has a frequency range of DC to 1.6 MHz, with sine, square, triangle, and ramp waveforms. Up to 16 preset frequencies can be programmed into memory and automatically sequenced in the "frequency hop" mode. Tone burst can be generated with the external trigger/gate feature, while internal linear/log sweep is available across the entire frequency range.

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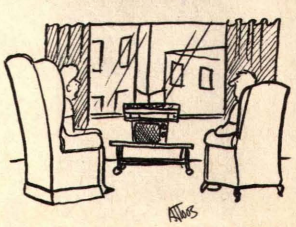
The function generator has a 32-character, two-line liquid-crystal display with a keyboard and rotary encoder for selecting functions and tuning frequencies. The rotary encoder allows analog-style tuning, while the keyboard provides direct access and mode selection.

The digitally controlled output is 20 volts peak-to-peak into an open circuit, 10 volts peak-to-peak into 50 ohms, with DC offset adjustment. An optional RS-485 serial interface is offered. Resolution to 0.001 Hz is stated, and frequency stability is guaranteed to ± 10 ppm. It offers six operational modes.

The Model 2003 synthesized function generator has a price of $499.95.

Global Specialties
70 Fulton Terrace
New Haven, CT 06512
Phone: 800-572-1028
Fax: 203-468-0060 ■



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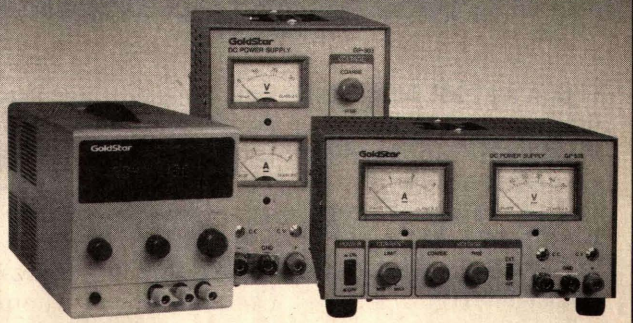

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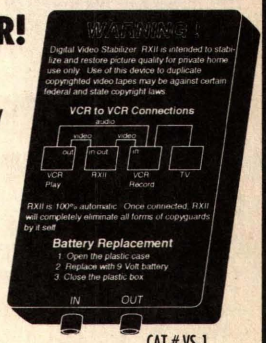
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NEW LITERATURE

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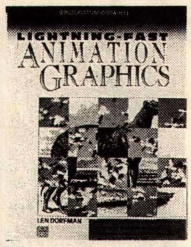
Lightning Fast Animation Graphics; by Len Dorfman. Windcrest/McGraw-Hill, Blue Ridge Summit, PA 17294-0850; Phone: 1-800-233-1128; Fax: 717-794-2103; $34.95 including diskette.

This book and computer disk package is intended for C programmers who develop high-speed graphics and special effects for the personal computer without the benefit of a graphics coprocessor. The book includes a disk library of sprite management routines that emulate segments of the graphics coprocessor. These routines allow programmers to create graphic elements easily for full-motion game, animation, and multimedia programs.



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The C code published here demonstrates the process of creating bit-plane graphics for video applications and is compatible with any DOS-and VGA-equipped PC. It also shows how to represent on screen the fast, smooth movement of sprite graphics in all directions, with full collision detection support.

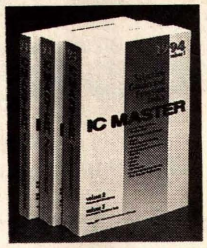
Step-by-step instructions lead readers through the process of creating three types of graphics objects found in arcade-style animation programs: sprites, missiles, and bullets. By emulating some elements of a graphics coprocessor, the disk of C library functions allows users to animate those graphics objects more easily for video games and special effects.

An explanation of how to integrate the bit-plane animation functions with Borland's and Microsoft's Graphic Interfaces is included. It presents functions and corresponding source code for smoothly moving graphics objects within a bit-plane in all directions, the detection of collisions between sprites, missiles , and bullets, and the design of multi-colored sprites.

1994 IC Master. Hearst Business Publishing/UTP Division, 645 Stewart Avenue, Garden City, NY 11530; Phone: 516-227-1314 (for credit-card orders: 1-800-833-7138); Fax: 516-227-1453. $180 plus $10 shipping and handling.

The 1994 edition of the IC master is an updated and expanded three-volume, 3000-page catalog that provides technical and sourcing information on all commercially available integrated circuits. It is also available on CD-ROM. Among the more than 100,000 commercially available ICs are listed more than 17,000 that appear for the first time.

Volume 1 lists ICs by type, function, and key parameters.



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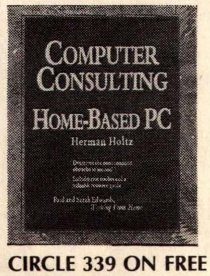
Volume 2 is presents part-number identification, military parts, and alternate sources. The part number index helps to find specific devices by starting with base number or complete part number.

Volume 3 contains technical data pages submitted by the manufacturers on their newest and most popular devices and information on their availability. Two free updates are included in the price.

Computer Consulting on Your Home-Based PC; by Herman Holtz. Windcrest/McGraw-Hill, Blue Ridge Summit, PA 17294-0850; Phone: 1-800-233-1128; Fax: 717-794-2103; $14.95.

This book explains how you can make use of your computer expertise and a home personal computer to set up your own computer consulting business. Holtz answers many of the obvious general questions one might have about a home consulting practice.



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It offers practical guidance on deciding what services you are best able to provide, how to market those services effectively, and how to build a professional reputation. Other topics covered are the identification and winning of clients, how to set competitive prices and how to get referrals.

DC/DC Converter Product Guide. Calex Mfg. Co. Inc., 2401 Stanwell Drive, Concord, CA 94520-4841; Phone: 800-542-3355; Fax: 510-687-3333; free.

Calex has included more than 100 new power-con-

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version products in its new 35-page DC/DC converter guide. The catalog also provides information on Calex's linear power supply and instrumentation products. The guide includes key specifications, product descriptions, case dimensions, and UL approval information. It also introduces Calex's FaxFACTS fax system for obtaining complete specifications and applications notes on the company's DC/DC converters and other power products.

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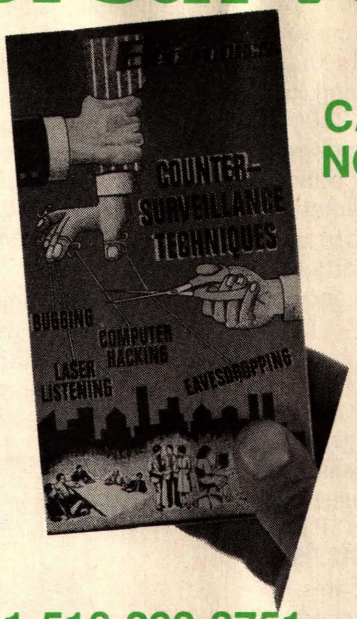

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Illustrated Novell NetWare 2.X/3.X Software; by Timothy K. McDonald. Wordware Publishing, Inc., 1506 Capital Avenue, Plano, TX 75074; Phone: 214-423-0090; $23.95.

This book was written as a guide to Novell NetWare's solutions to data and resource sharing. It explores the features, limitations, and options involved in configuring and installing the hardware and software required for a customized network.

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Software commands are illustrated with examples, and common mistakes are pinpointed and explained. The book features alphabetized commands for easy reference, hundreds of examples, practice exercises, hands-on learning activities, and a simple-to-complex recommended learning sequence.

Consumer-Electronic Repair Parts and Accessories Catalog. MCM Electronics, 650 congress Park Drive, Centerville, OH 45459-4072; Phone: 1-800-543-4330; free.

The latest catalog

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Number 33 from MCM Electronics lists more than 21,000 products that the company is offering, including more than 2800 new items. The company distributes semiconductors, speakers, connectors, test equipment, computer products, and parts for the repair of audio and video equipment.

Build Your Own Computer; by Kenneth Leigh Hughes. Wordware Publishing, Inc., 1506 Capital Avenue, Plano, TX 75074; Phone: 214-423-0090; $12.95.

The writer of this book, Ken Hughes, asserts that his book can even teach those with no knowledge of computers how to assemble a complete IBM-PC/AT or compatible personal computer system. It also contains the necessary in-

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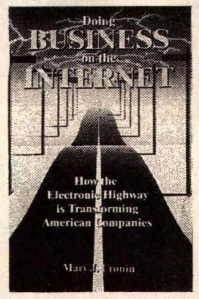
structions in software installation to help the do-it-yourselfer get his new computer up and running.

The book is organized into sections that introduce the reader to computer concepts before presenting instructions on how to assemble and operate the computer. It includes an overview of the IBM personal computer, and describes its separate components and their functions. Hughes also offers advice on how to shop for components needed to build a new computer or upgrade an old one.

Doing Business on the Internet: How the Electronic Highway is Transforming American Companies; by Mary J. Cronin. Van Nostrand Reinhold Publishing Company, 115 Fifth Avenue, New York, NY 10003; Phone: 1-800-544-0550; $29.95.

This non-technical guide is filled with facts and strategies on the Internet that hold enormous promise for businesses seeking to im-



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prove productivity and expand in the global marketplace. It is intended to reassure those who might be too intimidated by the technology to take advantage of the Internet's abundant information resources.

Cronin's book explains the basics of the technology, including how to get connected. Case histories of the benefits of Internet to businesses illustrate the various different ways that the Internet can be used effectively.

The book is based on an analysis of the results that were obtained by more than 100 large and small companies that are now on Internet. It examines, from a management perspective, the costs and benefits of various business applications.

The book also explains how to customize the Internet for product development, business partnerships, research, marketing, entrepreneurial opportunities, and customer support. Practical advice on the most important resources, services, and technical developments is offered.

The U.S. Consumer Electronics Industry in Review:1994 Edition. The Electronic Industries Association Consumer Electronics Group, 2001 Pennsylvania Avenue, NW, Washington, DC 2006-1813; Phone: 202-457-8700; Fax: 202-835-8939; single copy, free (send self-addressed envelope with $1.44 in postage); 2 to 49 copies, $1.50 each; 50 to 99 copies, $1.25 each; more than 100 copies, $.75 each.

This 110-page booklet is the latest version of a review updated annually by the Consumer Electronics Group of the Electronics Industries Association (EIA/CEG). It reports the achievements, breakthroughs, milestones, and

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trends that are constantly occurring in the consumer-electronics industry.

The review contains statistics, tables, and charts covering factory and unit sales, product development and marketing trends. The booklet also includes a history of the consumer-electronics industry, a list of available publications and participating firms, and a list of allied associations. Ω

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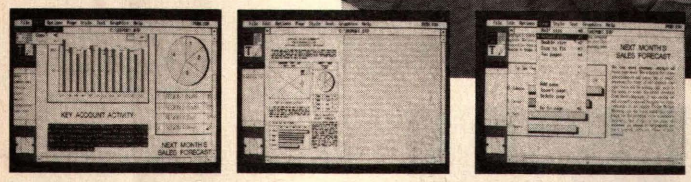

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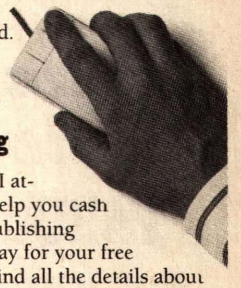

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LETTERS

continued from page 12

COMPUTER CONNECTIONS CLARIFICATION

I want to comment on Jeff Holtzman's "Computer Connections" column in the August 1994 *Electronics Now*. I have been a software engineer for several decades so I believe I am qualified to make my comments. I wrote my first software program back in 1959 on an IBM 650 computer with vacuum-tubes and relays.

First, Mr. Holtzman implies that the architecture drawing shown as Fig. 1 on page 16 is new, but it is not. I first saw a similar diagram years ago in the IEEE POSIX.0 working group. (POSIX is a group working on a generic operating-system standard.) I believe the original diagram, which was somewhat more detailed than Fig. 1, was submitted by Hewlett-Packard.

Second, Mr. Holtzman refers to *widgets*, and says they came from the Taligent effort. That is definitely not true. Widgets originated at MIT as part of the X Windows effort on the Athena Project. Widgets are dynamic objects, visible on the front panel of the computer, that are used for control purposes. Examples are a file list, a pushbutton, or a menu bar. Taligent simply cannot take credit for inventing widgets.

I believe that Fig. 1 is misleading. Holtzman's text stated layer five is the user layer, yet layer five is also shown as the graphics user interface (GUI) layer. I reviewed my notes and found a similar diagram presented in POSIX.0. The major distinction is that the POSIX diagram bound the operating system between the platform and the applications. It was shown as three boxes, not one.

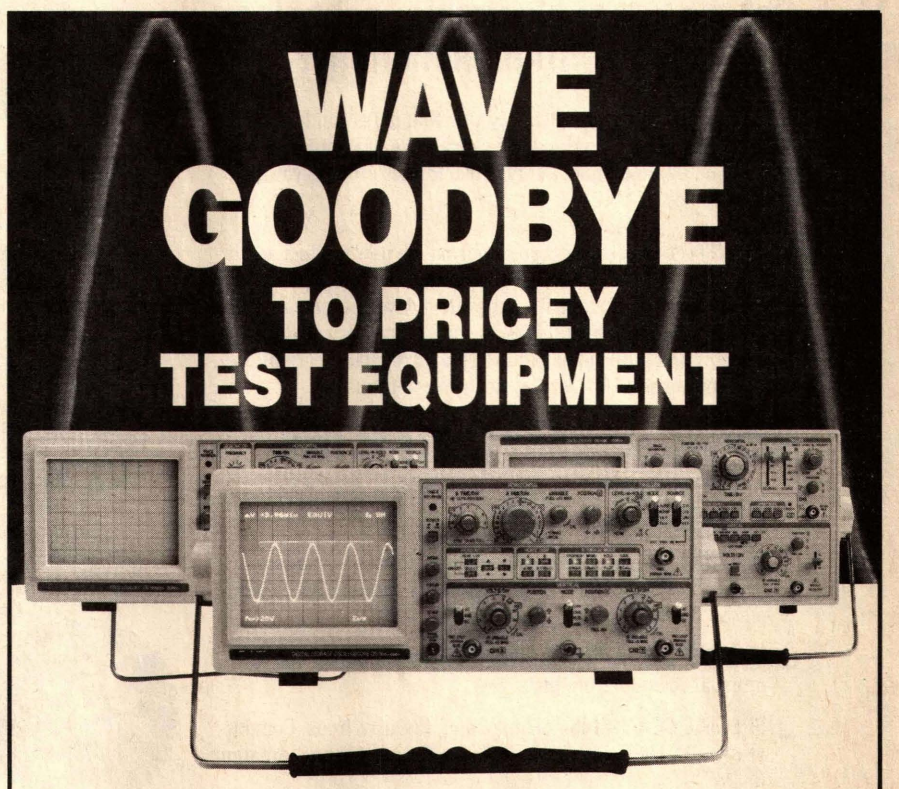
Fig. 1 would be more realistic if the POWER/INTEL box were removed from the super box and put below it. Then a new box labeled APPLICATIONS should be placed above the existing super box. I don't agree with the location of the GUI and WIDGET boxes, but that is more a matter of style than concept.

I believe that referencing the POSIX.0 guide document would help to describe the present state of operating-system technology. Then it would be informative to contrast it with the IBM strategy.

Holtzman's article also said: "Another way that IBM's model differs from previous architectures... ." The sentence would be more accurate if IBM were inserted so the sentence reads, "... previous *IBM* architectures." IBM's model does not differ from other vendor models at the level described. Yes, the architecture is a significant departure from IBM's past, but then IBM is trying to catch up with the industry.

IBM played ostrich for too long a period while the industry took off in another direction, leaving it behind technically. Unfortunately, I think the same arrogance that caused IBM to

Continued on page 89



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The TextGrabber

Make transcripts of your favorite television programs and download them to your PC.

KELLY McARTHUR

HAVE YOU EVER WANTED A HARD copy of the script from your favorite television program? Do you wish you could receive transcripts of important news programs without the trouble and expense of sending for them through the mail? The TextGrabber will let you capture a transcript of any closed-captioned television program for the hearing impaired. All you do is connect a video source to the TextGrabber, and connect the TextGrabber to your personal computer through its serial port. Then by running suitable communications software, you can capture the text encoded with the broadcast TV signals! Note that the TextGrabber works by itself, and does not require a separate closed-caption decoder.

VBI data transmission

Closed captions are added to the NTSC television signal as serial bit streams that occur on line 21 of the odd field during the vertical blanking interval (VBI). Figure 1 shows the data format in which two characters are sent on line 21. The text transmission rate of the VBI data system is determined by the number of VBI lines transmitted, the number of characters per line, and the frame rate of the television signal. For closed-captioning, the data rate is:

Two characters/line × one line/frame × 30 frames/second = 60 characters/second

VBI data transmission can deliver different kinds of information. With an inexpensive, settop, closed-caption decoder or a newer television set with built-in decoding, the hearing-impaired can read what is being said during the program as the words flash on the screen. Closed captioning is now included in most programming on the major networks.

Teletext information is also sent by the VBI transmission. In this mode, a decoder blanks normal programming and displays other information on the full screen. Teletext is not widely used in the United States, but it is popular in some countries in Europe.

Closed caption and teletext transmissions both use line 21 of the odd video field. Multiplexing permits the two data streams to be transmitted on the same television channel. Moreover, captions and teletext each support two different languages. Therefore, the following four separate data streams can exist on a single television channel simultaneously:

1) Captions Language 1
2) Captions Language 2
3) Teletext Language 1
4) Teletext Language 2

In the United States, Teletext and second language information is normally transmitted only during prime-time programming. The Teletext mode, for example, can transmit a programming guide listing upcoming shows that are closed-captioned. The second language mode (Language 2) usually displays a message advising the user to switch his decoder back to Language 1 to receive program captions. The vast majority of closed captioning is seen with a decoder set to the Caption mode for Language 1.

Figure 2 shows the format of the serial data in the VBI. Each "block" shown represents a start bit and two seven-bit characters with parity. Several of the important control codes are shown. Those are the only codes to which the TextGrabber responds. There are other control codes that affect different parts of the display of an on-screen caption decoder. Those include codes for italics, underlining, text color, and position. Those codes are ignored by the TextGrabber and eliminated from the output unless its "raw" data mode is selected. The TextGrabber has no use for those codes. The raw data mode is provided in case you have an application that can use them.

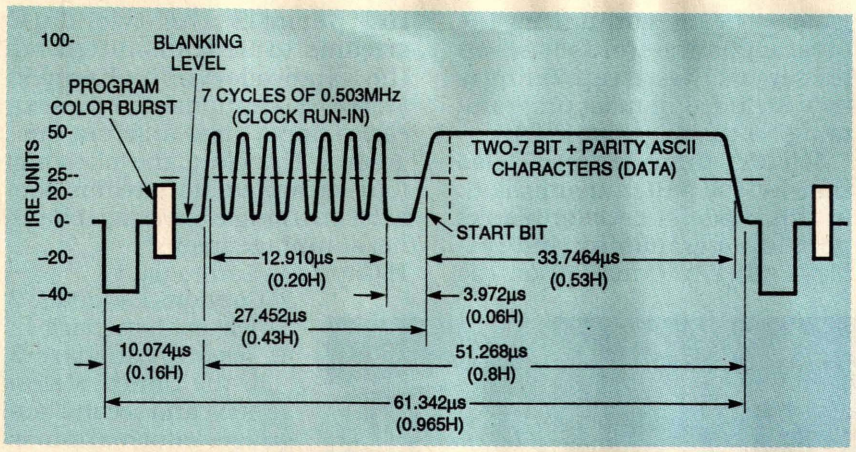

FIG. 1—CLOSED CAPTION DATA FORMAT. Captions are added to the television signal as serial bit streams that occur on line 21 of the odd field during the vertical blanking interval (VBI).

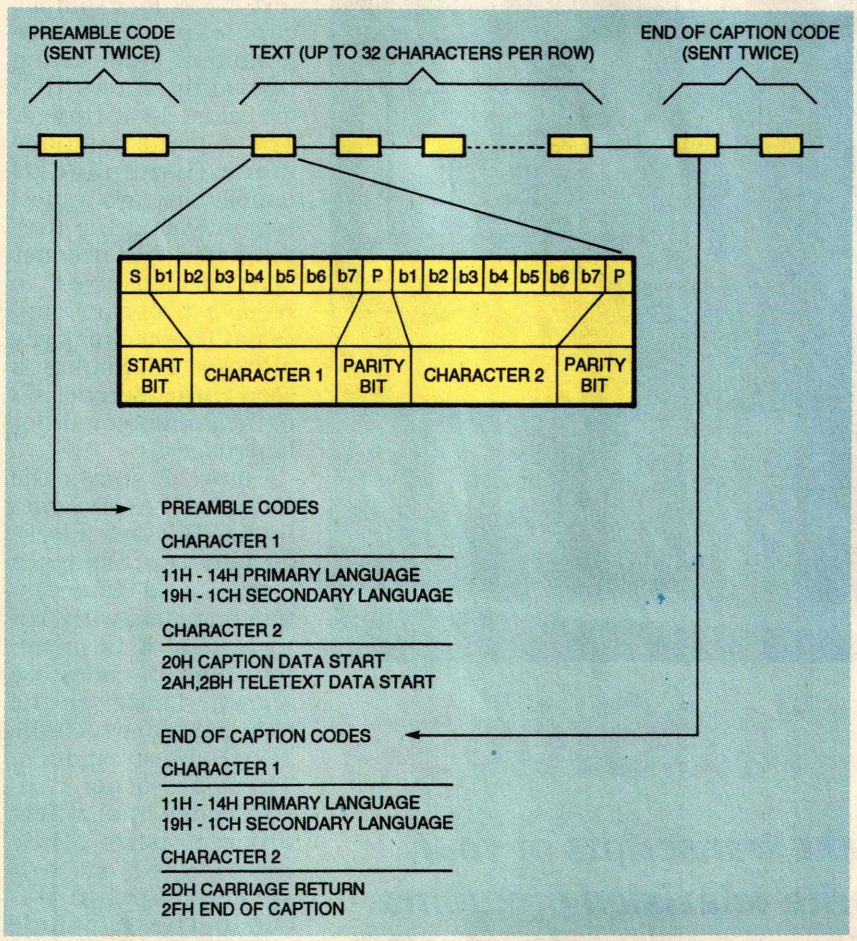
PREAMBLE CODE (SENT TWICE)
TEXT (UP TO 32 CHARACTERS PER ROW)
END OF CAPTION CODE (SENT TWICE)
S b1 b2 b3 b4 b5 b6 b7 P b1 b2 b3 b4 b5 b6 b7 P
START BIT
CHARACTER 1
PARITY BIT
CHARACTER 2
PARITY BIT
PREAMBLE CODES
CHARACTER 1
11H - 14H PRIMARY LANGUAGE
19H - 1CH SECONDARY LANGUAGE
CHARACTER 2
20H CAPTION DATA START
2AH,2BH TELETEXT DATA START
END OF CAPTION CODES
CHARACTER 1
11H - 14H PRIMARY LANGUAGE
19H - 1CH SECONDARY LANGUAGE
CHARACTER 2
2DH CARRIAGE RETURN
2FH END OF CAPTION

FIG. 2—VBI SERIAL DATA. Each "block" as shown represents a start bit and two seven-bit characters with parity.

TextGrabber hardware

Figure 3 shows a simplified schematic of the TextGrabber. A baseband video source such as a VCR is connected to J1. The video signal is terminated on the TextGrabber, and a buffer drives the video back out to J2. No termination is required if the output jack is left unconnected. Relay RY1 bypasses the buffer when the unit is turned off.

The video buffer and PLL section is shown in Fig. 4. Video is decoupled by capacitor C39 and then buffered by an amplifier formed by Q1 and Q2. Resistors R3 and R4 set the input bias level. The overall gain given by 1+R6/R7 = 2. Amplified video is buffered to J2 by emitter-follower transistor Q3.

Unbuffered video is sent to IC1, an LM1881 sync-separator, which extracts timing information from the video signal. The following signals are extracted: $\overline{\text{CSYNC}}$ (composite sync), $\overline{\text{VSYNC}}$ (vertical sync), $\overline{\text{BURST}}$ (colorburst), and $\overline{\text{EFIELD}}$ (even video field).

$\overline{\text{CSYNC}}$ is applied to one-shot IC2-a, set to around 45 microseconds, and then to IC2-b, set to around 10 microseconds, to filter the serrations out of the composite sync signal and provide a clean horizontal sync signal ($\overline{\text{HSYNC}}$) for the counters.

The $\overline{\text{BURST}}$ signal from the sync separator momentarily closes analog switch IC7 during the colorburst signal, which applies the video signal to the sample-and-hold circuit formed by R19, C28, and IC8. The time constant of R19 and C28 is slow enough to filter out the 3.58-MHz color subcarrier present during the burst. As a result, C28 maintains a voltage equal to the black level of the video signal. Diode D1 is biased to provide a reference voltage equal to the voltage drop across the diode that tracks the variations in the black level. A voltage divider consisting of R29 and R30 provides a clipping level about 0.3 volt above the black level as a reference to the comparator IC5. Digital data is then extracted from the video and sent to the inputs of the shift registers shown in Fig. 5.

Positive-going $\overline{\text{HSYNC}}$ pulses are applied to the input of IC3, a 74HCT4046 phase-locked loop (PLL) IC. This PLL contains both an edge-triggered phase comparator and voltage-controlled oscillator (VCO). A low-pass filter consisting of R13, R14, C27, and C42 smoothes out the phase error signal and applies it to the input of the VCO at pin 9. The output clock signal is sent to counter IC4, which divides the signal by 32. A reference signal is then fed back to the second phase-comparator input, closing the loop. This response sets the operat-

ing frequency of the PLL to 32 times the video's horizontal frequency, or 504 kHz.

The digital data stream from the comparator is sent to a pair of serial-to-parallel shift registers, IC10 and IC11, in Fig. 5. The regenerated 504-kHz clock signal ($\overline{32H}$) drives the SRCLK pin (shift-register clock) of the shift registers, which causes them to sample the data and shift it through the registers.

Programmable array logic (PAL) IC9 decodes the five bits from counter IC4. It also detects a signal from the microcontroller that indicates that line 21 of the video signal is present, and the $\overline{EFIELD}$ signal that indicates that the odd video field is present. The PAL then asserts the RCLK signal that causes IC10 and IC11 to latch the data in the shift registers on the particular clock cycle when the two bytes from the sampled

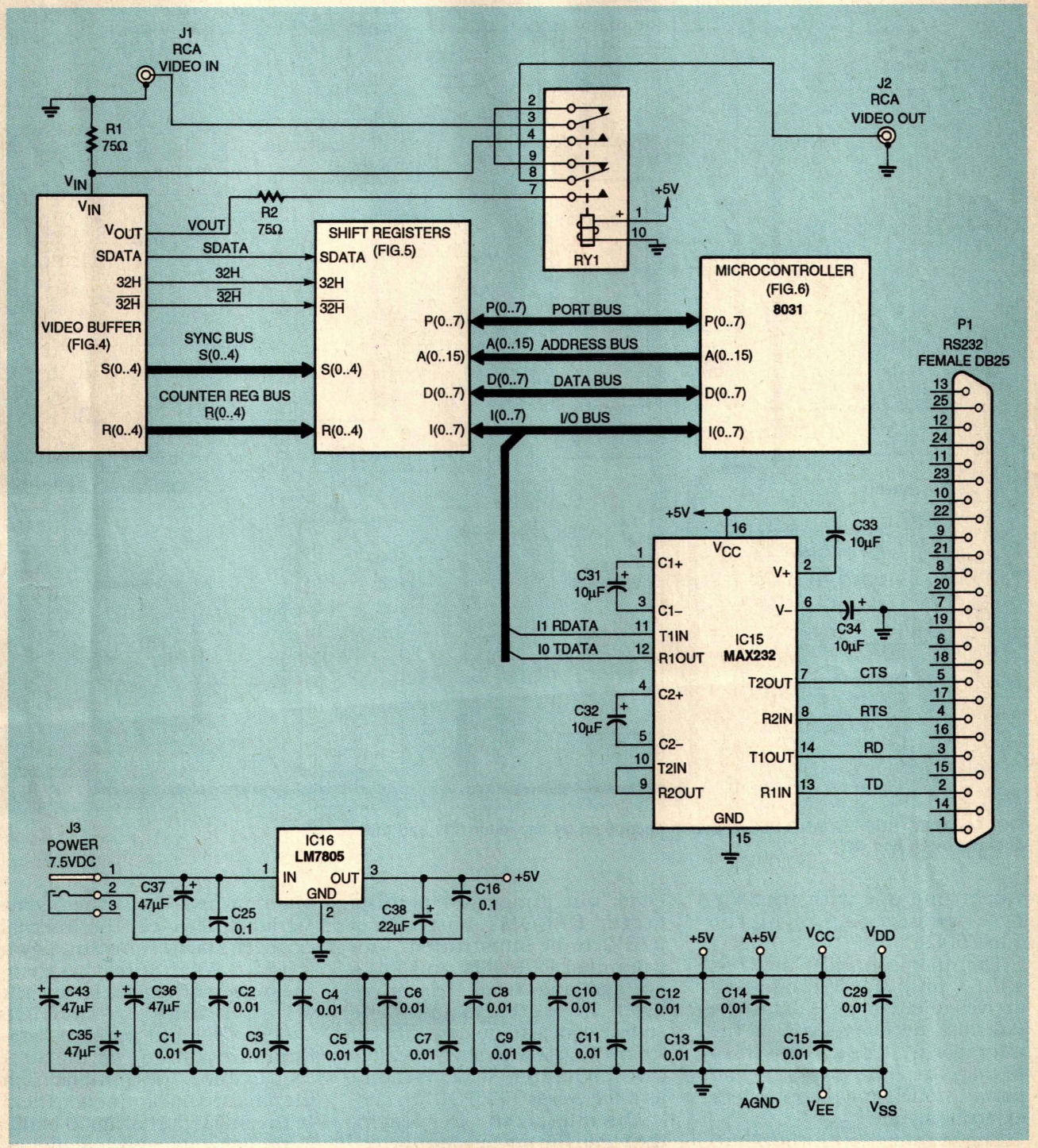

FIG. 3—TEXTGRABBER BLOCK SCHEMATIC. A base-band video source is connected to J1. The video signal is terminated on the TextGrabber, and a buffer drives the video back out to J2.

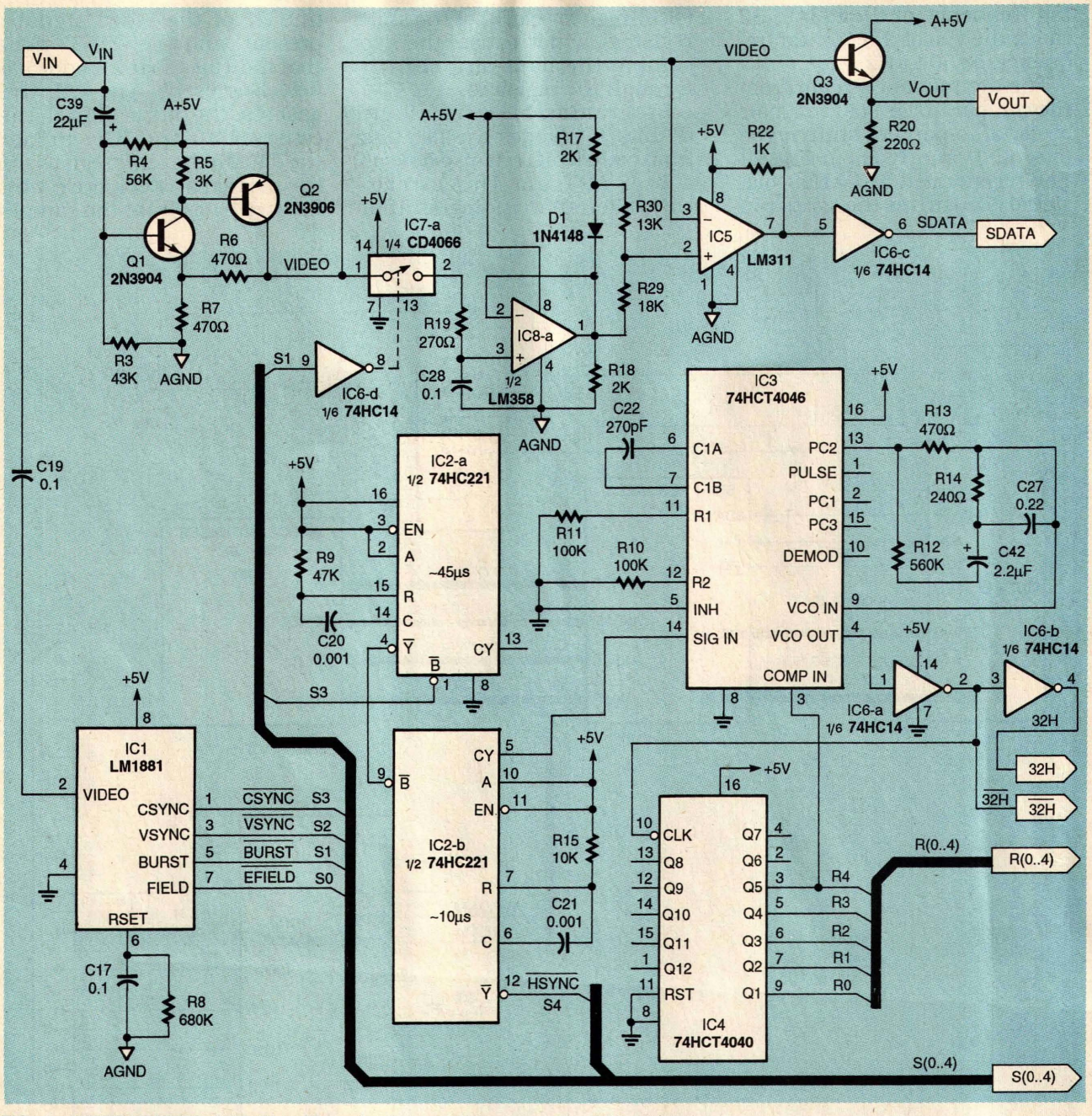

FIG. 4—VIDEO BUFFER AND PLL. Video is decoupled by capacitor C39 and then buffered by Q1 and Q2.

video "line up" with the two-byte wide registers of the 74HC595s.

The microcontroller now has a delay until the next odd field arrives to retrieve the data. The PAL also decodes some of the microcontroller's address lines to map the shift register's read ports into the microcontroller's external memory.

The firmware for the 8031 microcontroller is contained in EPROM IC14 (see Fig. 6). A 2764 has enough memory for the code, but jumper J4 permits larger EPROMs, such as a 27512 to be substituted. Programmed EPROMs and PALs are available from the source given in the Parts List. The source code can be downloaded from the *Electronics Now BBS* (516-293-2283, V.32, V.42bis) as a file called TEXTGRAB.ZIP.

The microcontroller tracks the video timing by monitoring $\overline{\text{VSYNC}}$, which is connected to External Interrupt 0, and $\overline{\text{HSYNC}}$ which is connected to Timer Input 0. When the vertical sync signal is detected, the internal counter starts counting down from 21. When it reaches zero, the processor toggles Port 1, Bit 0 (pin 1) high, so that IC9 latches the shift register data. Firmware running on the 8031 then extracts the captions from the data stream and sends them to the serial port at 9600 baud. A MAX232 chip (designated as IC15 in Fig. 3) provides the proper ±10-volt levels needed for RS-232C.

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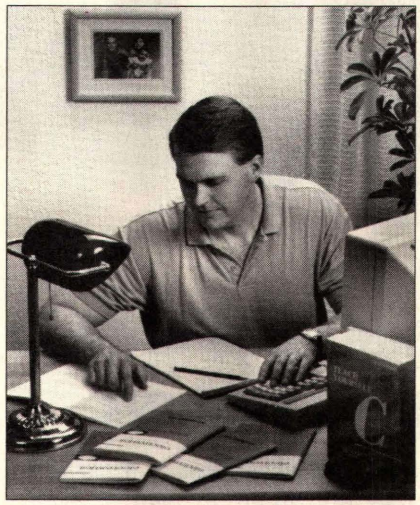

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By Charles Anton

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Now there is a car alarm that *will protect you and your family.* It is the first of its kind to focus on the safety of the vehicle owner as well as the vehicle itself.

Protect yourself. It all begins with the panic button. Imagine you're walking to your car at night and a person approaches. Pushing the panic button on your transmitter lets your car come alive with a shrieking siren and flashing headlights. While the panic alarms of other vehicle security systems have a range of 100 feet, the Smart Alarm's panic alarm lets you call for help or scare away potential attackers from up to 400 feet!

Exclusive feature. Unlike other car alarm systems that begin and end their focus on personal protection with the panic alarm, that's just the beginning of the Smart Alarm. In addition to the panic alarm, the Smart Alarm also has a car finder feature. You'll never again have to wander around a dark and dangerous parking lot searching for your car. You will be able to know where your car is from anywhere within 400 feet by flashing its lights and briefly sounding the siren. You can activate and deactivate your car's headlights by remote control to light your way in a dark driveway or parking lot.

Carjacking. The Smart Alarm also addresses a growing hazard for today's motorists—carjacking. It's alarming how often drivers are hurt in their cars because they refuse to give them up to carjackers. Because of its anti-carjacking device, the Smart Alarm allows you to safely retain your car when confronted by a carjacker. This is made possible by a delayed panic alarm.

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- **Range.** Most car alarm features only work up to 100 feet away—all Smart Alarm features work up to 400 feet away.
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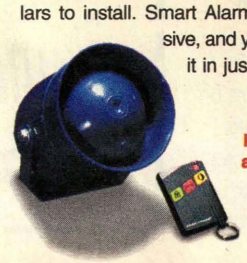
- **Car finder.** Your car will be able to let you know where it is by flashing it's lights and briefly sounding the siren.
- **Carjacking.** Its delayed panic alarm allows you to safely prevent theft of your car when confronted by a carjacker.
- **Easy installation.** Other car alarms are complicated or cost hundreds of dollars to install. Smart Alarm is inexpensive, and you can install it in just minutes.



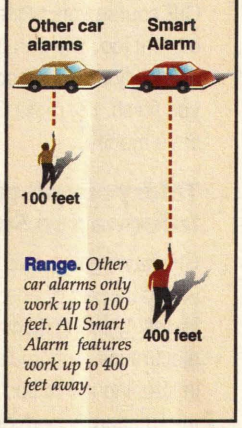
Smart Alarm is the first car alarm that will protect you and your family.

Easy installation. *Installing the Smart Alarm requires no fumbling with wires. Special Plug-In Connectors let you install the Smart Alarm without a single wire-cutter! Simply unplug the headlight connector, plug in the Smart Alarm connector, and then plug the headlight connector to the Smart Alarm. Connect the Smart Alarm to the battery cable with the special clip. In minutes, you and your car can enjoy complete 24-hour protection. Away from your car, you'll feel safer knowing that your car is protected! Near your car, you'll feel safer knowing that you are protected!*

All you do is give up your car and activate the delayed panic alarm. When the assailant has reached a safe distance and is no longer a threat to you, a deafening 120dB siren and flashing lights will force him to flee your car, letting you recover it safely.

Vehicle protection. Smart Alarm's current sensor triggers the siren if the trunk or any of the doors are opened while the alarm is armed. To supplement the current sensor, a shock sensor triggers the siren when it detects a blow to your car. Together, these sensors provide your car with blanket protection.

Compare



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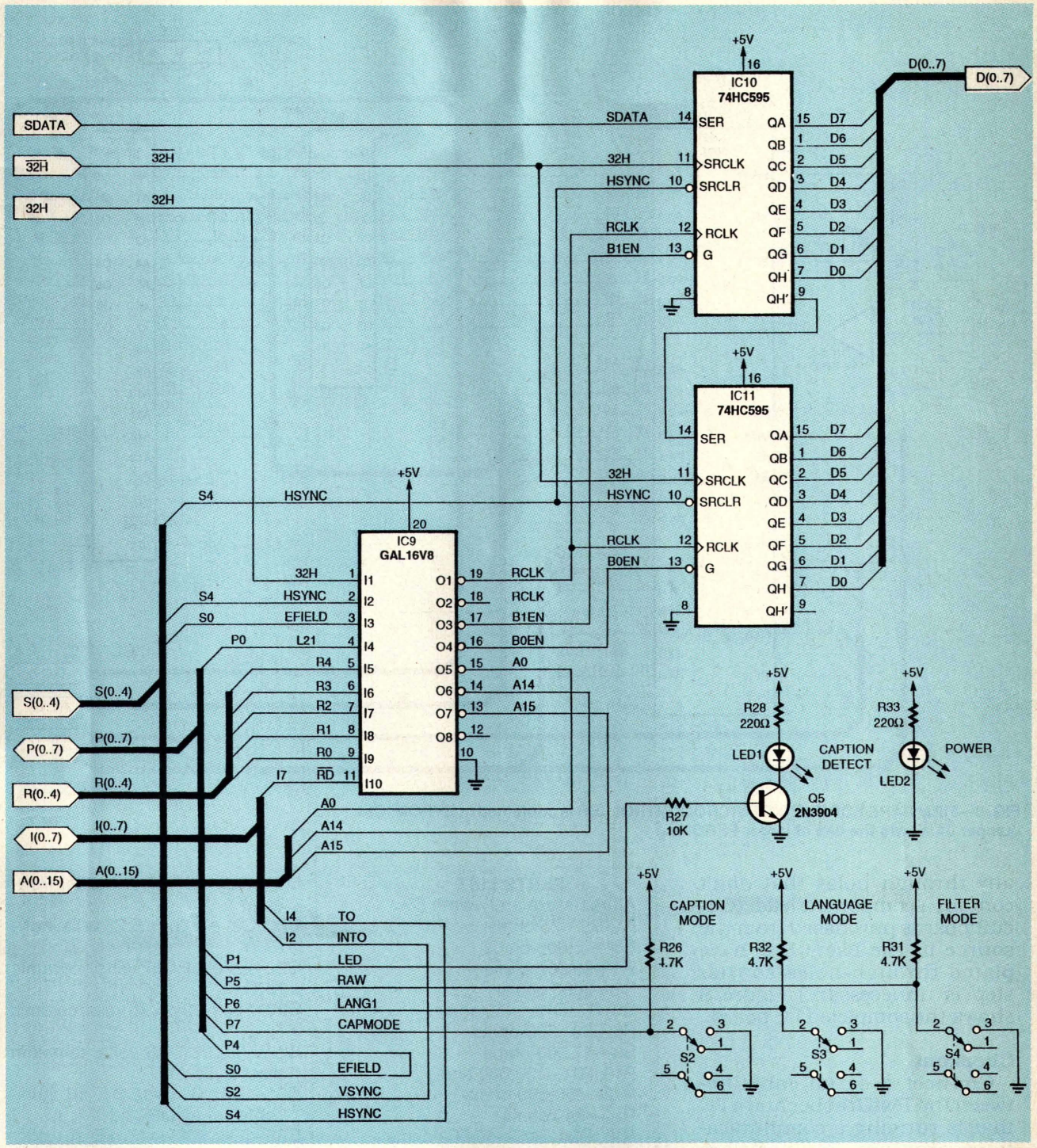


FIG. 5—THE DIGITAL DATA STREAM from the comparator is sent to a pair of serial-to-parallel shift registers, IC10 and IC11. PAL IC9 asserts the RCLK signal that causes IC10 and IC11 to latch the data in the shift registers.

Construction

A printed circuit board is recommendedfor the construction of the TextGrabber. You can fabricate a PC board yourself from the artwork provided in this article, or obtain an etched and drilled board from the source given in the Parts List. If you make your own board, be aware that there are several vias on the board where copper traces must jump from one side of the board to the other. Short lengths of bare copper wire must be inserted and soldered on both sides.

Install the components as shown in the Parts-Placement diagram in Fig. 7. If you have made your own double-sided board, be sure to solder all of the component leads on both sides of the board because many of the traces depend on component pins to provide a connection from one side to the other. Also, install a wire jumper in

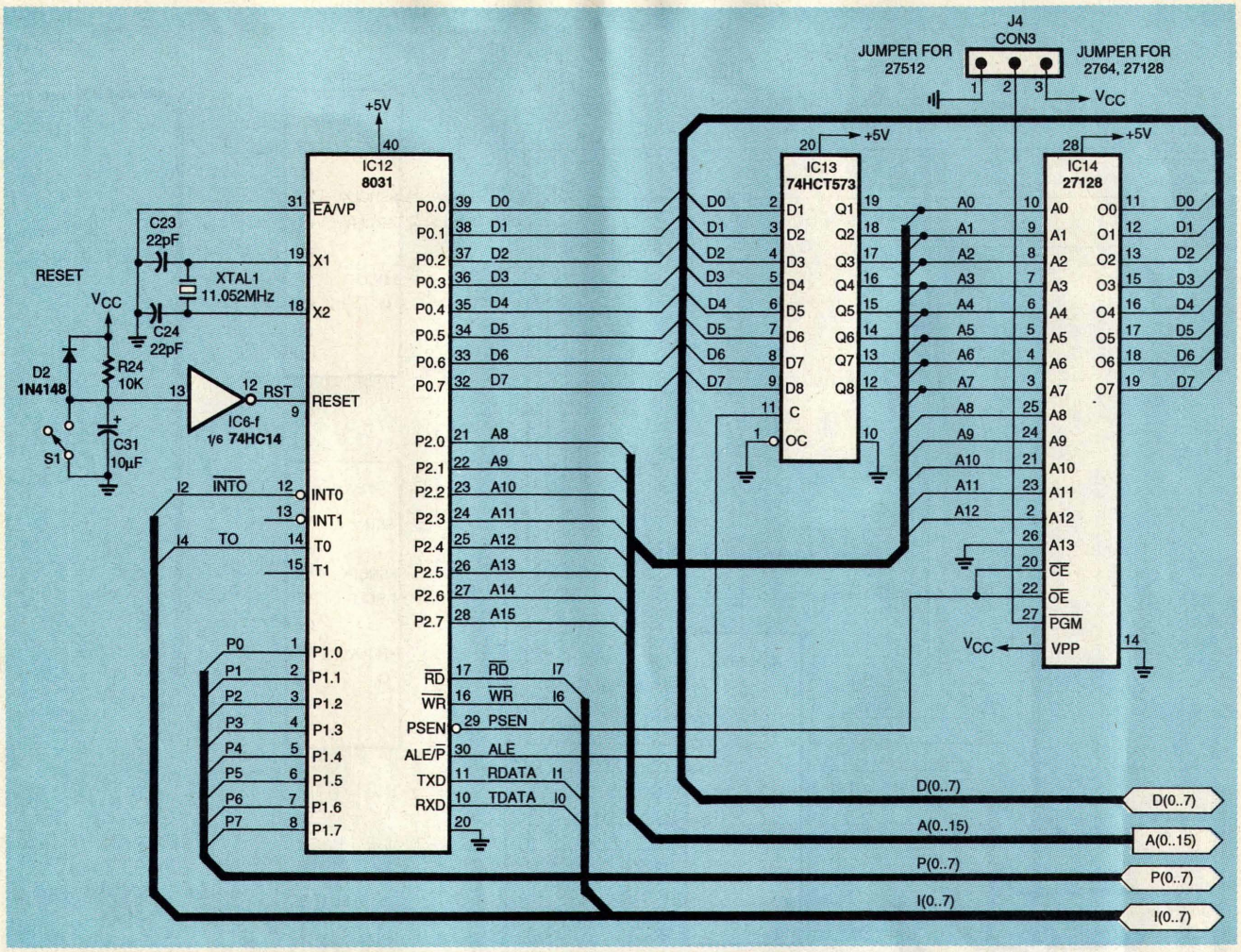


FIG. 6—FIRMWARE FOR THE 8031 MICROCONTROLLER is contained in EPROM IC14. Jumper J4 allows the use of larger EPROMs.

any through holes that don't contain a component lead. (Circuit boards purchased from the source in the Parts List have plated through-holes so that step is unnecessary.) Figure 8 shows the completed PC board.

Checkout

Connect a serial cable between the TextGrabber and a PC that is running a communications program. The software should be set to communicate over a direct connection at 9600 bps. Then connect a "clean" video source to the video input connector. Apply power to the TextGrabber; the message "<READY" will appear on the screen. This indicates that the microcontroller is up and running. If no video source is detected, the TextGrabber will also send "<NO VIDEO SIGNAL" to the terminal.

PARTS LIST

All resistors are ¼watt, 5%.

R1, R2—75 ohms
R3—43,000 ohms
R4—56,000 ohms
R5—3000 ohms
R6, R7, R13—470 ohms
R8—680,000 ohms
R9—47,000 ohms
R10, R11—100,000 ohms
R12—560,000 ohms
R14—240 ohms
R15, R24, R27—10,000 ohms
R17, R18—2000 ohms
R19—270 ohms
R20, R28, R33—220 ohms
R22—1000 ohms
R26, R31, R32—4700 ohms
R29—18,000 ohms
R30—13,000 ohms

Capacitors

C1–C15, C29—0.01 µF, 25 volts, monolithic
C16, C17, C25—0.1 µF, 25 volts, monolithic
C18, C26, C29, C30, C40—not used
C19, C28—0.1 µF, 25 volts, Polyester
C20, C21—0.001 µF, 25 volts, Polyester
C22—270 pF, 25 volts, ceramic NPO
C23, C24—22 pF, 25 volts, ceramic NPO
C27—0.22 µF, 16 volts, tantalum electrolytic
C31–C34, C41—10 µF, 16 volts, Tantalum electrolytic
C35–C36, C43—47 µF, 16 volts, Tantalum electrolytic
C37—220 µF, 25 volts, electrolytic
C38, C39—22 µF, 16 volts, tantalum electrolytic
C42—2.2 µF, 16 volts, tantalum

Semiconductors

D1, D2—1N4148 diode
LED1—green light-emitting diode
LED2—red light-emitting diode
Q1, Q3, Q5—2N3904 NPN transistor
Q2—2N3906 PNP transistor
IC1—LM1881 sync separator
IC2—74HC221 multivibrator

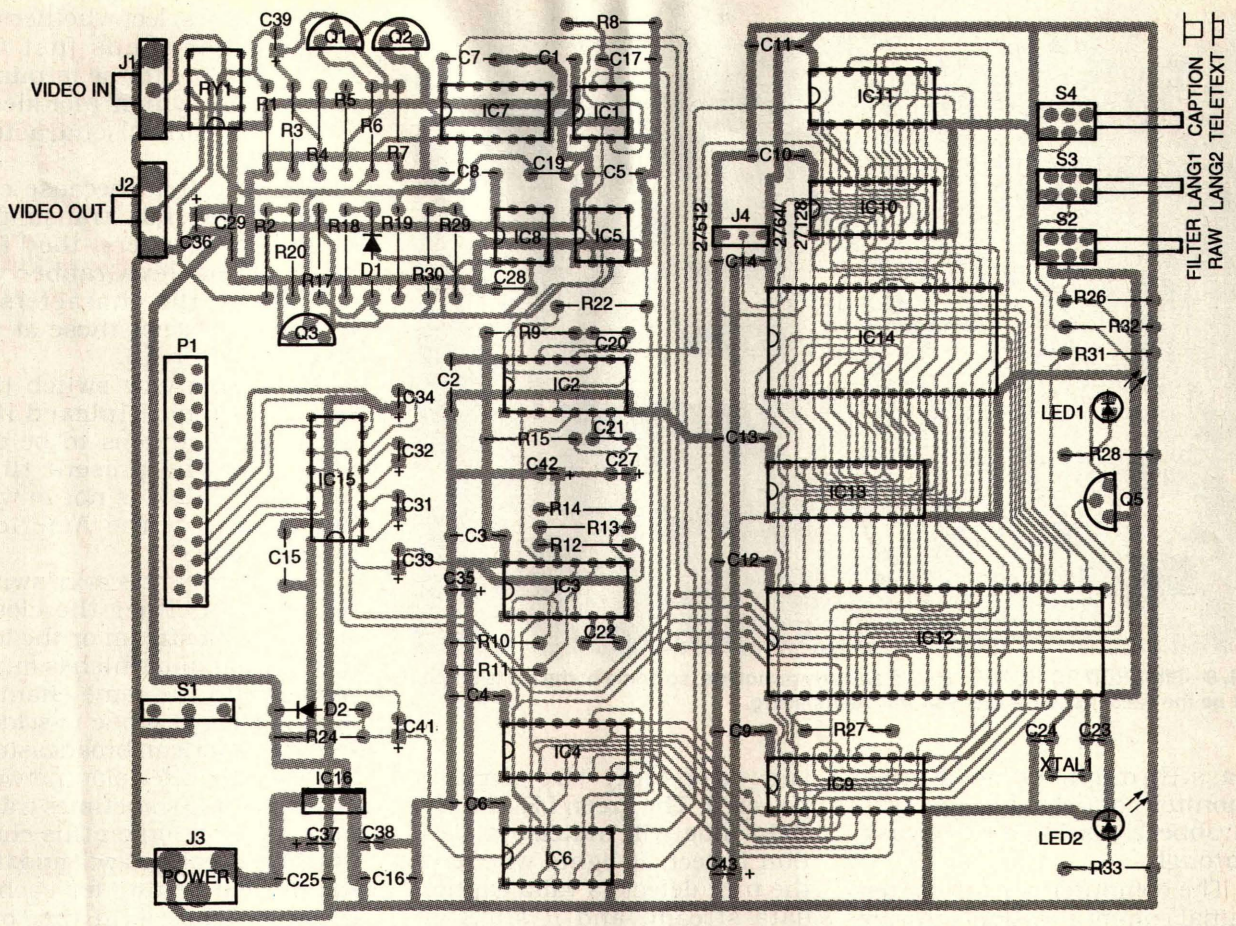


FIG. 7—PARTS PLACEMENT DIAGRAM. If you make your own double-sided board, solder all of the component leads on both sides of the board, and install a wire jumper in any through holes that don't have a component lead in them.

IC3—74HCT4046 PLL
IC4—74HCT4040 counter
IC5—LM311 comparator
IC6—74HC14 hex inverter
IC7—CD4066B quad bilateral switch Harris or equiv.
IC8—LM358 op-amp National or equiv.
IC9—GAL16V8-25 programmable logic device
IC10, IC11—74HC595 shift register
IC12—8031 microcontroller
IC13—74HCT573 latch
IC14—27C64 EPROM
IC15—MAX232 RS232 transceiver
IC16—LM7805 voltage regulator

Other Components

J1, J2—PC-mount RCA connector
J3—PC-mount coaxial power connector
RY1—DPDT—relay, 5-volt coil
P1—PC-mount female DB25 connector
S1—SPST momentary-contact pushbutton switch
S2–S4—PC-mount DPDT switch (push-on, push-off type)
XTAL1—11.0592 MHz crystal

Miscellaneous: PC board, 7.5-volt DC 500 milliampere power supply, project case, cables.

Note: The following items are available from Willamette Designs, 2373 NW 188th Ave. No. 236, Hillsboro, OR, 97124:

- **Complete TextGrabber kit including PC board, and all electrical components (no case or power supply)—$149.95**
- **PC board—$20**
- **Programmed PAL and EPROM—$20**

Please add $5 for shipping and handling on the complete kit, $2 for PC board and PAL/EPROM orders. Check or money order only.

- **A fully assembled and tested TextGrabber with case and power supply is available for $249.95 from Software South Inc., 10010 Abercorn No. 3, Savanah, GA 31406 (800) 899-3950, (912) 925-0082.**

If the microcontroller is working properly, check the video section by first examining the outputs of the sync-separator (IC1) with an oscilloscope to make sure they are active. Then follow the path of $\overline{\text{HSYNC}}$ through to the PLL, and verify that it is oscillating at the proper frequency (504 kHz), and that this clock signal is present at the shift registers (IC10 and IC11). If you have a two-channel oscilloscope, verify that the output of the sample-and-hold circuit (IC8 pin 1) tracks the black level of the buffered video signal, and that the comparator reference at pin 2 of IC5 remains about 0.3-volt above the black level.

Using the TextGrabber

Figure 9 shows a typical operating setup for the TextGrabber. The program being transcribed can be viewed either on a television connected to the VCR's RF

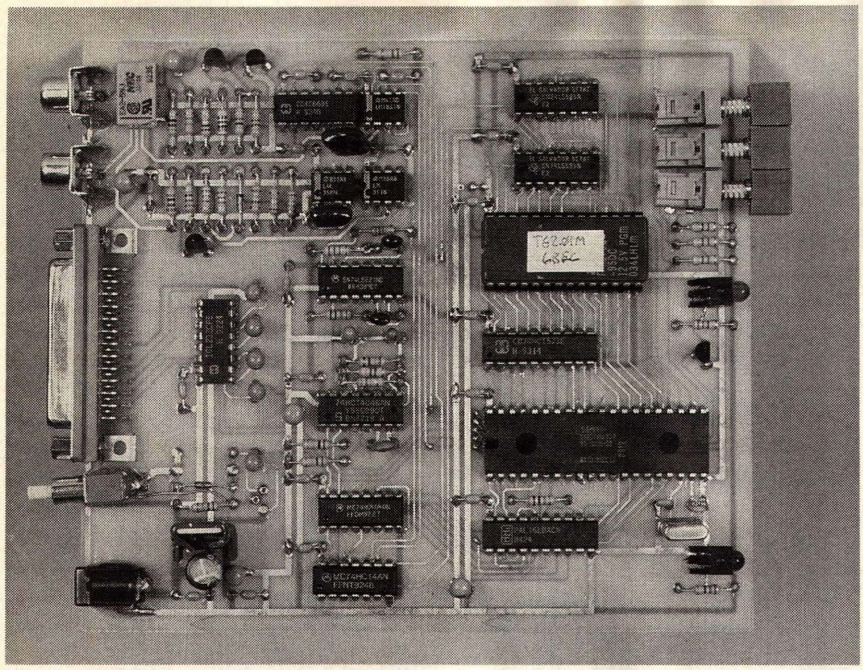


FIG. 8—FINISHED PC BOARD. This is an early prototype, so some of the parts might not be the same as those that you will be installing.

pass-through, or on a video monitor connected to the TextGrabber's baseband video pass-through.

The computer is running terminal communication software set to 9600 baud, 8 data bits, no parity bit, and one stop bit (8N1). The data from the TextGrabber is captured on the hard disk drive of the computer with the ASCII download feature of the terminal software being used.

The red LED on the left side of the front panel of the unit will indicate that the unit is powered. The green LED on the right side will indicate a Caption Detect. It lights whenever the unit detects a valid caption data stream, and it stays on while the data is being transmitted.

If the Caption Detect LED is not flashing periodically, then the television program you are watching probably doesn't have closed captions.

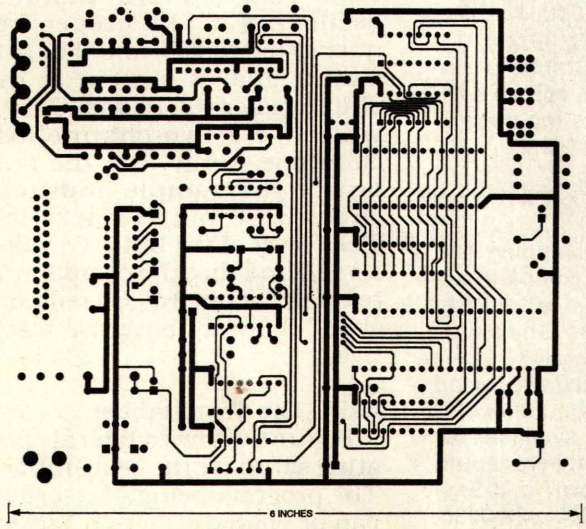
Three front-panel switches control various modes of operation. The FILTER/RAW switch (S4) allows you to select whether the TextGrabber sends just the ASCII captions to the terminal, or raw data which includes a stream of control characters and codes.

Also note that, because captions are generally transmitted in all capital letters, the Filter mode of the TextGrabber will convert all the characters to lower case except those at the start of a sentence.

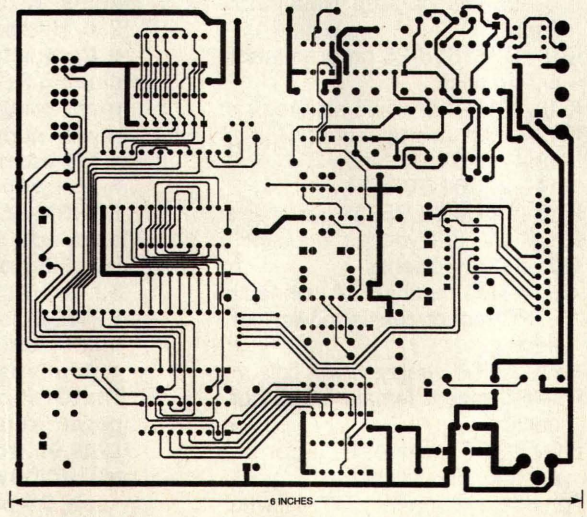
The LANG1/LANG2 switch (S3) selects the multiplexed language data streams to be displayed. At the present time, Language 2 data is not in wide use by any of the American broadcasters.

The CAPTION/TELETEXT switch (S2) selects either the closed caption data stream or the teletext data stream which is multiplexed onto the same channel. Again, Teletext mode is seldom used by American broadcasters, but the ABC television network programming sometimes transmits information on this channel. In general, you will find that the desired setting for each of these switches is in the "out" position.

The microcontroller will be reset by pressing reset button S1 on the back panel, and it will then transmit the "<READY" message. This feature is provided so that you can easily test the serial connection to the PC in the absence of a video signal that contains caption data.



COMPONENT SIDE of the TextGrabber PC board.



SOLDER SIDE of the TextGrabber PC board.

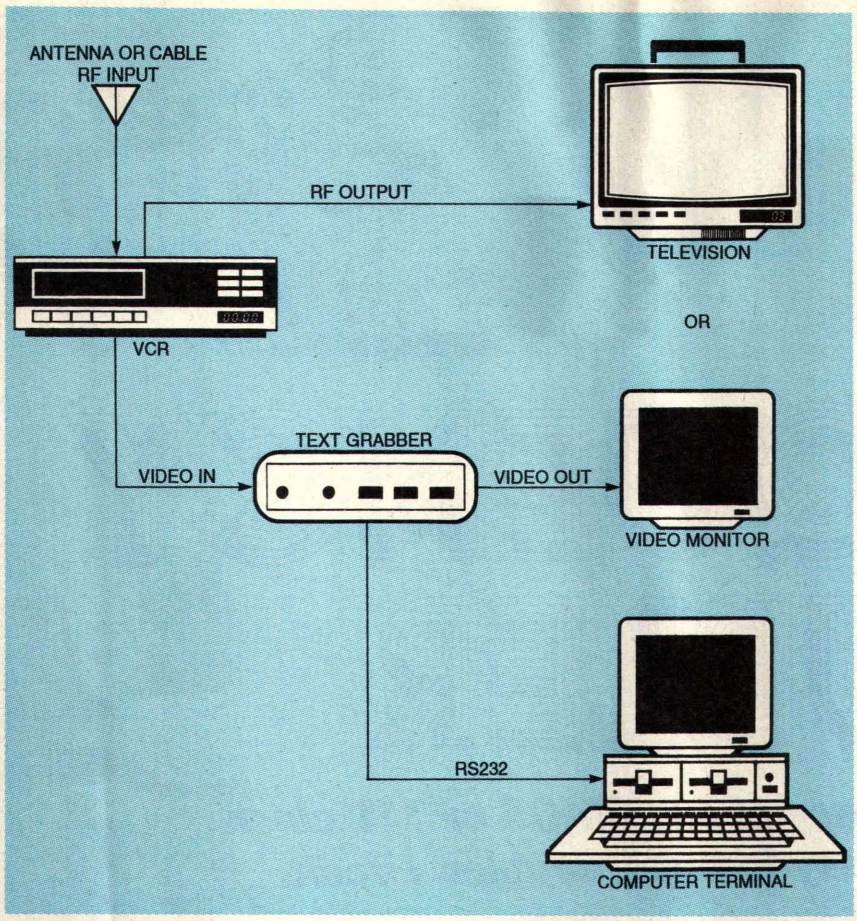


FIG. 9—TYPICAL TEXTGRABBER SETUP. The program being transcribed can be viewed either on a television connected to the VCR's RF pass-through, or on a video monitor connected to the TextGrabber's baseband video pass-through.

FIG. 10—THE TEXTGRABBER can be built in a compact cabinet.

For best results, the TextGrabber requires a clean video source. Like any other telecaption decoder, characters will be dropped and text will be garbled as the quality of the video signal degrades.

The TextGrabber will work with programs that have been recorded on videocassette tapes. However, be sure that you record tapes intended for use with the TextGrabber at your VCR's fastest tape speed (SP), and be sure that you have high-quality tapes for optimum video viewing and closed-caption decoding quality. Ω

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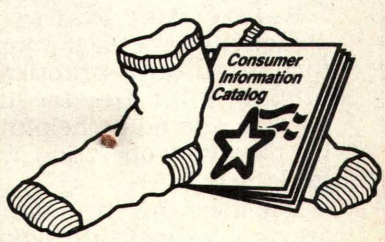

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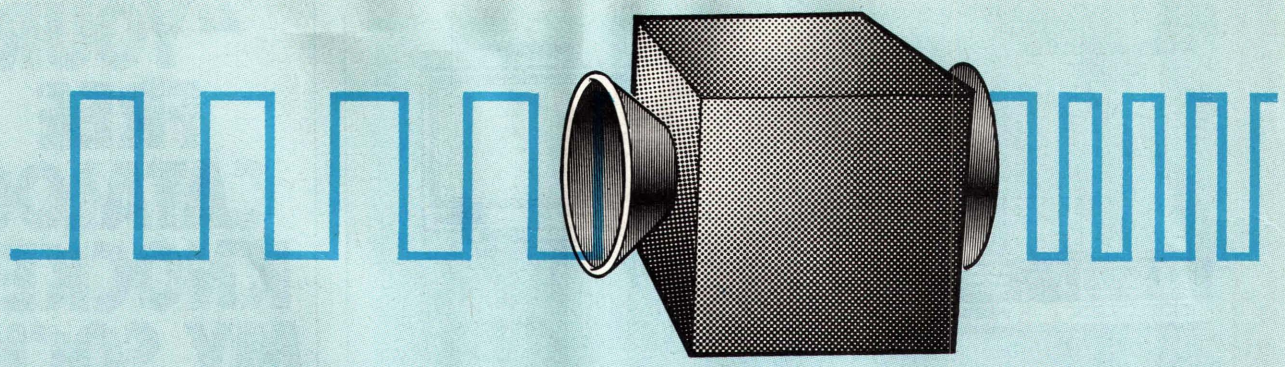


FREQUENCY DOUBLER

Double the frequency of any CMOS or TTL clock signal with this easy-to-build doubler circuit.

JOHN J. YACONO

A UNIVERSAL FREQUENCY-DOUBLING circuit will come in handy in your home shop or on the job. The subject of this article is the construction of a simple circuit that will double the frequency of a digital clock input and be independent of input frequency.

The entire circuit is based on a quad EXCLUSIVE-OR (XOR) gate whose output is 1 (logic high) if any but not more than one of its inputs is 1. The output is 0 if more than one input is 1 or if all inputs are 0. You can make a doubler circuit based on either the CMOS CD4070B or the TTL 74386 because these quad XOR devices are pin-for-pin compatible. A 14-pin socket will permit the devices to be interchanged.

Before discussing construction, some background information on a practical application for the frequency doubler should be helpful, and its theory of operation will be explained.

Consider this situation: You are troubleshooting a digital circuit with a digital logic analyzer and you see that the logic analyzer latches data on the same edge of the clock pulse each time a clock pulse arrives. If you set the analyzer to latch data on the rising edge of a clock pulse, the plot of the clock data will show a constant high. However, if you set the analyzer to latch data on falling transitions, the clock data will appear continuously low. Unfortunately, after you select the desired edge for triggering, you can view only half of the circuit activity and none of the clock transitions.

It is easy to see that under certain circumstances the logic analyzer would be useless. This situation could occur when troubleshooting a microprocessor or microcontroller circuit whose data is latched on one clock transition, processed, and then transmitted on the opposite clock transition.

If you were to view only data collected as it is presented for input or output, it would be impossible to determine if a malfunction were caused by signal-path propagation delays, device propagation delays, settling time, or incorrect processing. Of course, you must distinguish between those three causes to correct them. A digital frequency-doubler that can provide clock pulses for either rising or falling clock pulses (and still remain in-step) would be invaluable.

Operational theory

Propagation delay, a key characteristic of logic gates, is significant in any logic application. It is the time required for a change of logic at the input of a gate to affect the logic at its output. The longer the propagation delays of transistors in a signal path, the longer it takes to produce a usable result. It follows that integrated circuit designers are always trying to minimize propagation delays.

Ironically, a delayed clock signal can be useful in this frequency-doubler circuit. The output of an XOR gate is low when its inputs are equal, and high when its inputs are unequal. Consider what would happen if both a clock pulse and a

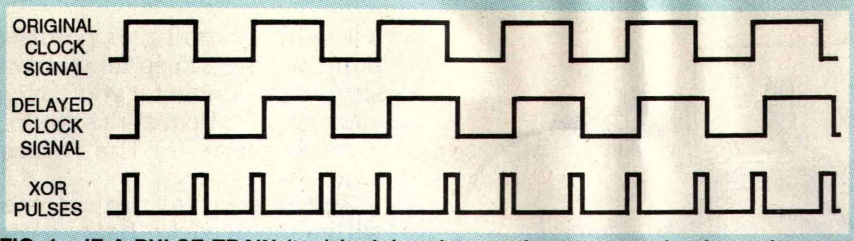


FIG. 1.—IF A PULSE TRAIN (top) is delayed to produce a second pulse train (middle) and both trains are passed into an XOR gate, a pulse train with variable-width pulses will be produced (bottom).

slightly delayed version of the same pulse are applied to the inputs of an XOR gate. The plot of pulses in Fig. 1 shows the original clock pules at the top and a delayed pulse below it.

The output of the XOR gate will appear like the lower waveform in Fig. 1. Thus, the XOR gate generates one pulse for each clock transition. As a result, the gate produces output pulses at twice the clock frequency, but they remain synchronized with the clock, as shown in the upper waveform.

The lower XOR waveform illustrates another important characteristic: the width of the XOR pulses equals the delay introduced to the clock signal or the difference between the rise times of the pules in the top and middle waveforms.

The XOR pulse width will respond to the delay time regardless of frequency with one condition: the delay introduced to the clock signal (the middle waveform) must be shorter than both the high and low times of the clock. Thus, the clock should be delayed by less than 180 electrical degrees if the doubler is to work properly.

This sets the criteria for a circuit that will double clock pulses, but the circuit requires a delayed clock pulse. Because an XOR gate can be configured as a buffer by grounding one of its inputs, and it has an inherent phase delay, the gate will function as delay line to stall clock pulses before they reach a second XOR gate.

The circuit

The frequency doubler circuit is shown in Fig. 2. It is powered by the DUT. This eliminates the need for additional circuitry and also "configures" the doubler to operate at appropriate logic-voltage levels. This is necessary for testing CMOS logic because of the wide range of operating voltages and logic levels.

In Fig. 2, IC1-a is the pulse-producing gate, and IC1-b, IC-c, and IC1-d form a variable-delay network. Each gate in the network adds its phase delay to the signal it receives. Thus, IC1-b delays the clock by one phase delay period, IC1-c delays it for an equal period, and IC1-d adds yet another delay.

The gates are arranged so that both the phase delay and the width of the output pulses can be selected by making wire changes on a header that carries the delayed signal to IC1-a. That feature has two functions: 1) it extends the duration of the output pulses for slower test equipment, and 2) decreases the pulse width for testing very fast circuits.

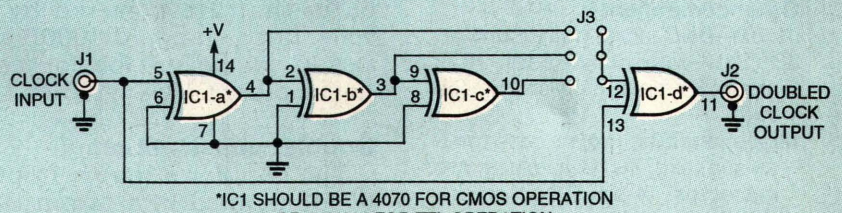
As stated earlier, you have a choice of quad XOR IC: a CMOS CD4070B or equivalent in a faster CMOS family (HC/HCT, HCS/HCTS, or ACL (FACT)) or a 74386 or its equivalent in faster TTL logic families (AS, LS, ALS, FAST). Your selection will determine the propagation delay of the gates. The delay is important because it determines the maximum input frequency that the circuit can handle and the maximum pulse width it can generate.

Maximum input frequency will limit the circuitry with which the doubler will be effective. Maximum pulse width will permit the circuit to work with the slowest test equipment. (Additional gates can be added to the delay network to increase the output pulse width for the slowest equipment.) To maximize the doubler's versatility, select a quad XOR with the highest maximum frequency that is compatible with your test equipment.

Table 1 provides information to help you select the optimum TTL family for your needs. The propagation delays are typical values obtained from data books, but devices from different manufacturers might have different typical values. The maximum output pulse widths given in the table were obtained by multiplying the

TABLE 1—TTL PROPATATION DELAYS VS. DOUBLER FREQUENCY LIMITS

TTL Family	Typical Delay (ns)	Maxcimum Input Frequency (Hz)	Longest Output Pulse (ns)
Advanced Schottky	1.5	166,667	4.5
Fast Schottky	2	125,000	6
Schottky	3	83,333	9
Advanced Low-power TTL	6	41,667	18
Low-Power Schottky	9	27,778	27
Standard TTL	10	25,000	30
Low-Power TTL	33	7,576	99



*IC1 SHOULD BE A 4070 FOR CMOS OPERATION OR A 74386 FOR TTL OPERATION

FIG. 2.—THE ACTIVE COMPONENT OF THE FREQUENCY DOUBLER is a quad exclusive-or (XOR) gate.

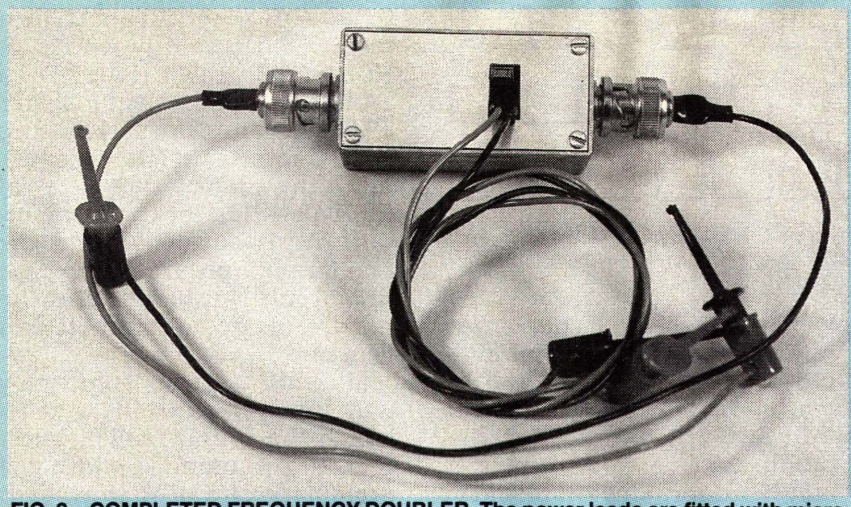
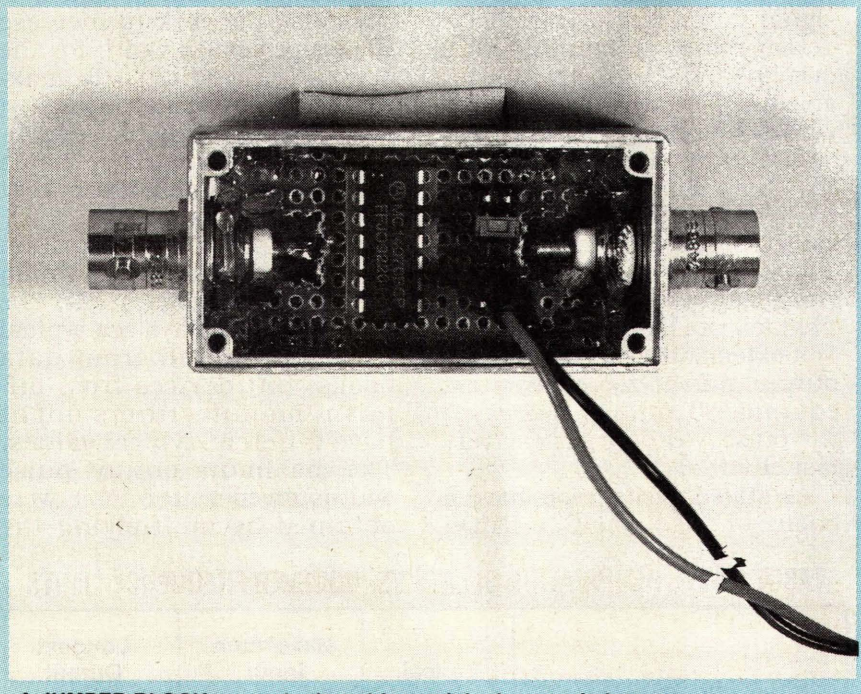


FIG. 3—COMPLETED FREQUENCY DOUBLER. The power leads are fitted with microclips and attached to two extra pins on the jumper block.



A JUMPER BLOCK was substituted for a triple-throw switch to conserve space.

propagation delay by a factor of 3 (the number of delay gates in the delay network).

Deciding on a CMOS IC is easier because even the fastest CMOS ICs are slower than the response times in most test equipment. A device from the high-speed HCT CMOS family is suitable for testing CMOS circuits that are powered by 5 volts, but a standard 4000B series IC will be suitable for testing all other CMOS circuits.

PARTS LIST

Semiconductor

IC1—quad XOR-gate, CMOS or TTL (see text)

Other components

J1, J2—BNC jacks, wall mount

J3 (S1)—four-pin header, PCB mount (or triple-throw switch, see text)

Miscellaneous: Project case (metal, see text), two BNC plugs, two microclips, 14-pin IC socket (see text), perforated construction board, heat-shrink tubing, insulated hookup wire, solder.

Doubler construction

The doubler circuit's 14-pin IC is mounted in a 14-pin DIP socket on a rectangular piece of perforated construction board. (Regardless of assembly method—wire wrapping or point-to-point wiring—keep all wires as short as possible.) If you design your own PC board, design in a ground plane on the reverse side.

Select a metal project case with a metal cover that will provide good shielding. The prototype is housed in an aluminum case measuring 5¼ × 3 × 2⅛inches. Holes are drilled in both ends of the metal case for BNC jacks J1 and J2. Another hole is cut in the case cover to allow the power and ground wires to exit.

In order to fit the circuit in such a small case, a 4 × 2 shorting header was used in place of a triple-throw switch for S1. The S1 connections are then made by moving a jumper. The two extra pins on the shorting jumper have leads attached to them for obtaining power and ground from the DUT. (You can prevent shorting between the closely-spaced power and ground jumper header pins with heat-shrinkable tubing, if necessary.) If you can find a small triple-throw switch you can use that, or use the header instead (as we did) or use a larger switch and bigger case.

Position the completed circuit board in the bottom of the case and fasten it in place with double-sided tape or RTV silicone. Pass the power leads through the hole in the cover and terminate them with microclips. Figure 3 shows the assembled frequency doubler ready to be put to work.

Testing the doubler

To test out the frequency doubler, feed in a signal of known frequency from a crystal-based reference or function generator and measure the output frequency with a frequency counter or oscilloscope. The doubler will double the input frequency if it is functioning correctly.

The details will not be described in this article, but you can increase the versatility of the frequency doubler by fitting it with an analog front end. An operational amplifier configured as a Schmitt trigger will perform this function. Ω

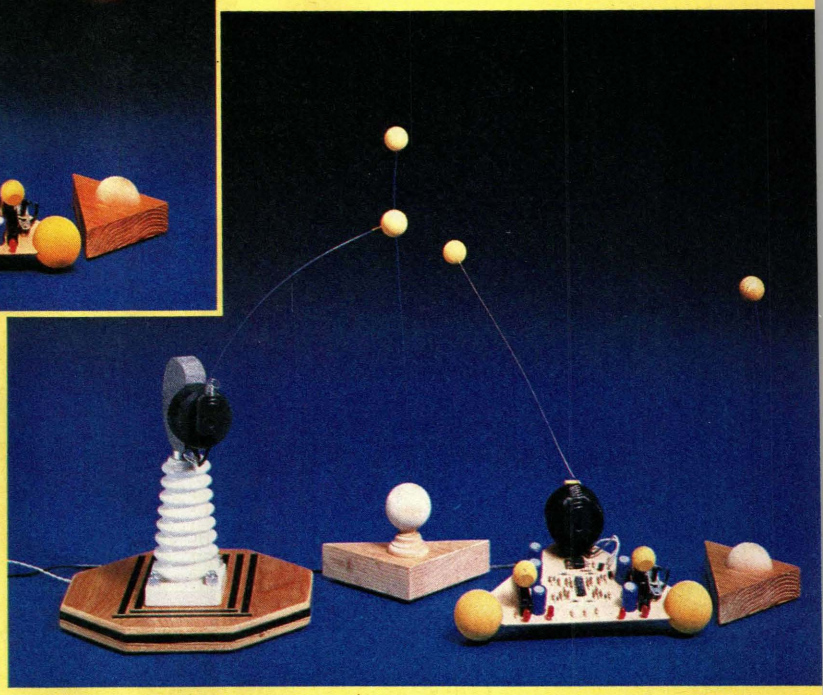


FIG. 1—WATCH THE DANCING BALL on the end of the spring. An erratically oscillating solenoid on the Bonker sends the ball into unpredictable gyrations captured with time exposure (left). The Bonker at rest (below). Spring-mounted balls on stationary bases add to the chaotic effect.

Build this fascinating device whose moving ball can hypnotize and captivate you with its random (chaotic) motion.

CREATING CHAOS

ROGER SONNTAG

DO YOU WANT RELIEF FROM THE MOnotonony of routine activities that get you down—daily commuting, your job, or those pesky chores that you must do every day? What you need is a little chaos in your life—safe and controlled, of course—at desktop scale. How do you do this? Build the Bonker and go a little crazy watching its bouncing ball whirl and spin in random loops. Then you'll be ready to return to your dull routine.

Unlike a clock pendulum or that executive toy with all its little suspended bearings that clatter back and forth, Bonker's action is completely unpredictable. And you can turn it off when you've had enough chaos for the day. Chaos is defined as extreme confusion or disorder and the kind of formless matter and infinite space that is said to have existed before the universe was ordered. In short, it's the opposite of orderly and predictable.

Figure 1 shows one Bonker setup. Small wooden balls on the end of wire springs are sent into wild gyrations by oscillating solenoids whose motion is controlled by a four-stage pulse generator. It's a fascinating and eye-riveting gadget that will evoke a lot of comments when it's running on your desk.

How does it work?

Figure 2 is a simplified schematic showing only one of the four pulse oscillator circuits that drive the rotary solenoid. Each oscillator is formed from an operational amplifier and a network of external components. Three other circuits similar to that shown on the left side of the diagram all feed the same common bus. The summed output of all four oscillators provides a variable pulsed drive signal for the MOSFET gate.

The MOSFET is in series with the solenoid's coil. When the MOSFET conducts, current flowing in the coil causes the solenoid shaft to oscillate back and forth within a limited angular sweep. Solenoid oscillation is controlled by the summed output of the four oscillator stages.

The op-amp shown in Fig. 2 is IC1-a, one of four op-amp circuits in a quad LM324 shown in Fig. 3, the complete schematic. Each of the four op-amp-based oscillators is identical except for different values of their *charge*

and *discharge* resistors. In Fig. 2, R2 in the feedback loop of the op-amp is the charge resistor, and R1 is the discharge resistor.

Diode D2 couples the output of the oscillator to the base of Q1 through resistor R23. Diodes D4, D6 and D8 perform the same functions for the other three oscillator stages formed from op-amps IC1-b, IC1-c, and IC1-d. When the output of any two oscillators is positive, Q1 conducts.

Resistors R4 and R5 divide the 12-volt power from a wall outlet adapter to obtain 6 volts. Positive feedback through resistor R3 cleanly switches the oscillator at each output state. Resistors with identical values in the other three oscillator circuits perform the identical functions.

Figure 3, the complete schematic, shows each of the four oscillator stages that include a LED. The first and fourth stages include a trimmer potentiometer to introduce additional variation in the pulse train.

The differences in the value of resistors R1, R6, R11 and R25 in parallel with grounded aluminum electrolytic capacitors C1, C2, C3 and C4 provide different time constants for each oscillator. The approximately ± 20 % variation in tolerances of those capacitors imparts additional randomness.

The differences in the values of the discharge resistors R1, R6, R11 and R25 (25 to 180 kilohms) determine the pulse duty cycle, and the 1-kilohm values of the charging resistors R2, R7, R12, and R24 determines pulse width.

Bonker action is initiated by closing switch S1. Light-emitting diodes LED1 to LED4 give visual indications of the output from each oscillator. Linear potentiometers R27 and R28 control the swinging of the ball. They can adjust the motion from a gentle swing to a wild, eccentric movement. Electrolytic capacitor C5 shunts any AC transients that might appear on the 12-volt source to ground. Table 1 summarizes the variations in pulse repetition rate that can be be set in each oscillator stage, as well as variations that can be introduced by the capacitor tolerance.

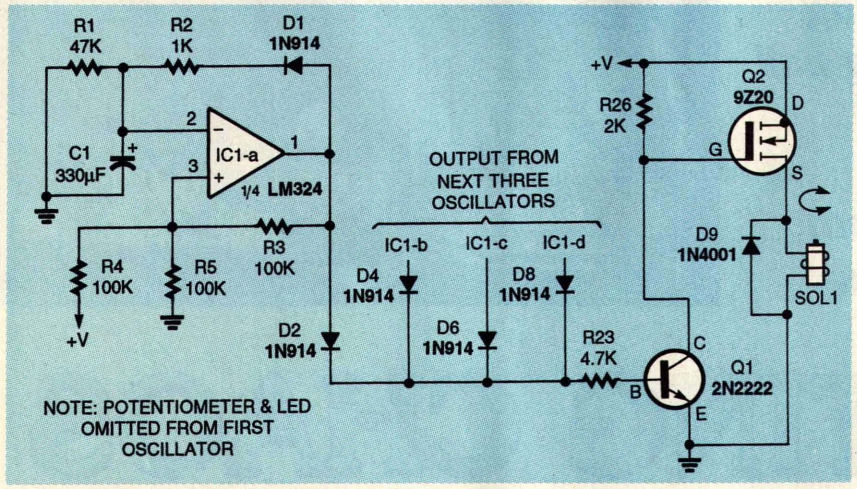


FIG. 2—A SIMPLIFIED SCHEMATIC to explain how the Bonker's solenoid drive circuit works.

Circuit construction

A printed circuit board is available from the source given in the Parts List. However, a foil pattern is included in this article for those who want to make their own circuit boards. There is nothing critical about parts placement in this circuit, so it could made with point-to-point wiring techniques if the parts placement diagram is followed.

Refer to the parts placement diagram Fig. 4. Begin assembly

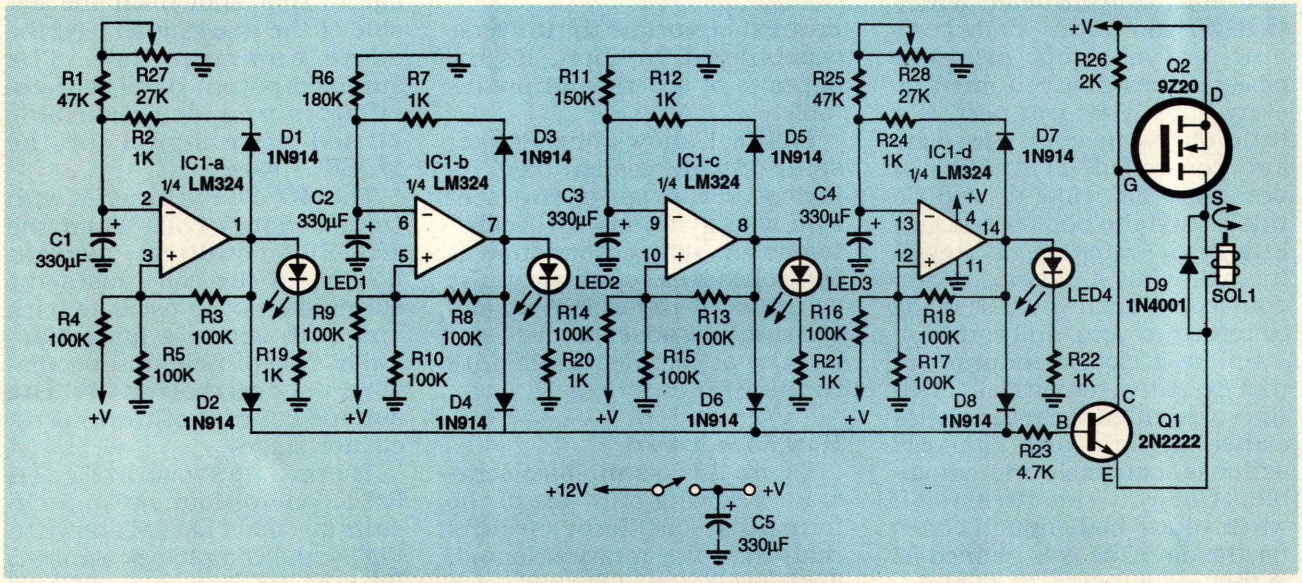


FIG. 3—SCHEMATIC FOR BONKER SOLENOID drive circuit. Four oscillator stages are formed from a quad LM324N op-amp IC. LEDs provide a visual indication of the pulse output of each stage.

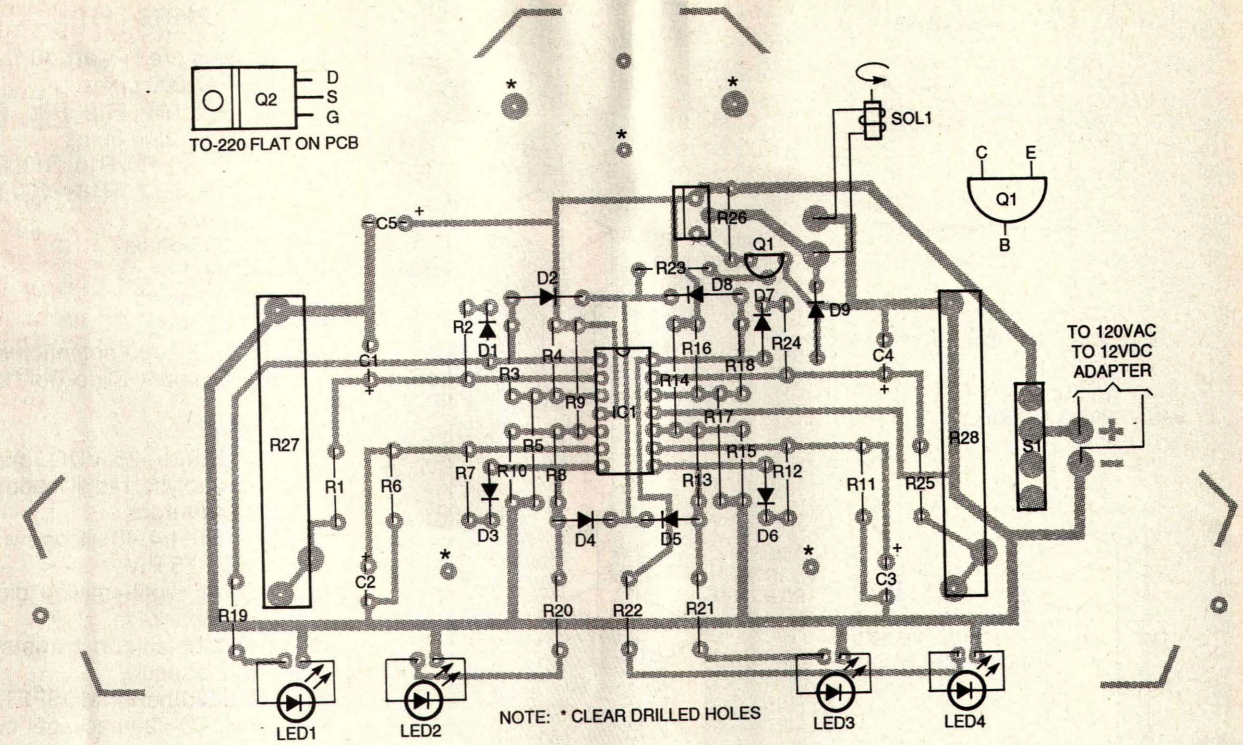
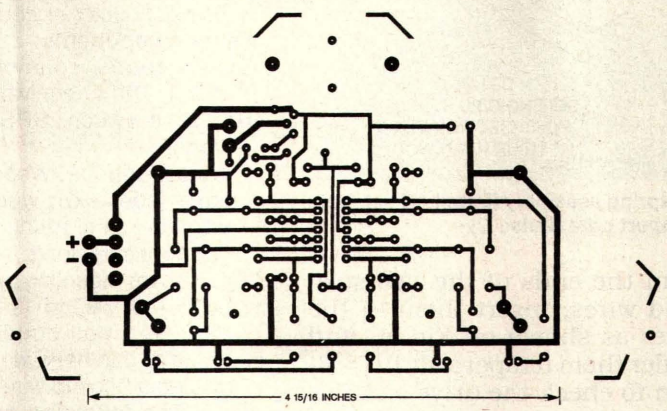


FIG. 4—PARTS PLACEMENT DIAGRAM for Bonker drive circuit. Bend the leads of MOSFET Q2 so it lies flat on circuit board.



FOIL PATTERN for Bonker drive circuit board.

TABLE 1
OSCILLATOR STAGE PULSE FREQUENCY

Oscillator Stage	Pulse Limits (Seconds)
1	4 - 10
2	20 + 20%
3	26 + 20%
4	4 - 10

of the components to the circuit board by inserting all fixed resistors (R1 through R26) in the board as shown. Bend their leads together to clamp them in position close to the board.

Then insert the radial-leaded aluminum electrolytic capacitors (C1 through C5) observing their polarities, as shown in Fig. 4. Bend their leads inwards to clamp them to the board.

Then insert all diodes (D1 through D5), again observing the positions of their anodes, as shown on Fig. 4. Bend their leads to clamp them in position. Solder all of these components to the circuit board, but do not trim the leads at this time.

Next, insert transistor Q1 and bend its leads to clamp it temporarily. Bend the leads of power MOSFET Q2 at right angles so that the heat sink of its TO-220 package will lie flat on the board when the leads are inserted in the proper holes of the board.

Insert trimmer potentiometers R27 and R28 and the four light-emitting diodes (LED1 to LED4) as shown in Fig. 4, but do not twist their leads to clamp them. Now solder the leads of the second group of components inserted.

Carefully file or trim off about one-third of the width of each of the four flat terminals of slide switch S1 uniformly so that they can be press fit in the assigned holes in the circuit board. Insert the switch in the circuit board and solder it.

Identify the plus (+) and (−) wires of the DC output cable of a 120 VAC to 12-volt, 1 ampere, DC-regulated adapter, cut off the coaxial jack, and trim the insulation back on the two wires. Insert them from the component side of the board in the (+) and (−) positions (marked on the foil side of the board), and solder them in position. Trim all excess lead lengths close to the board.

Note: The circuit and solenoid can be run from a battery pack consisting of eight 1.5-volt C or

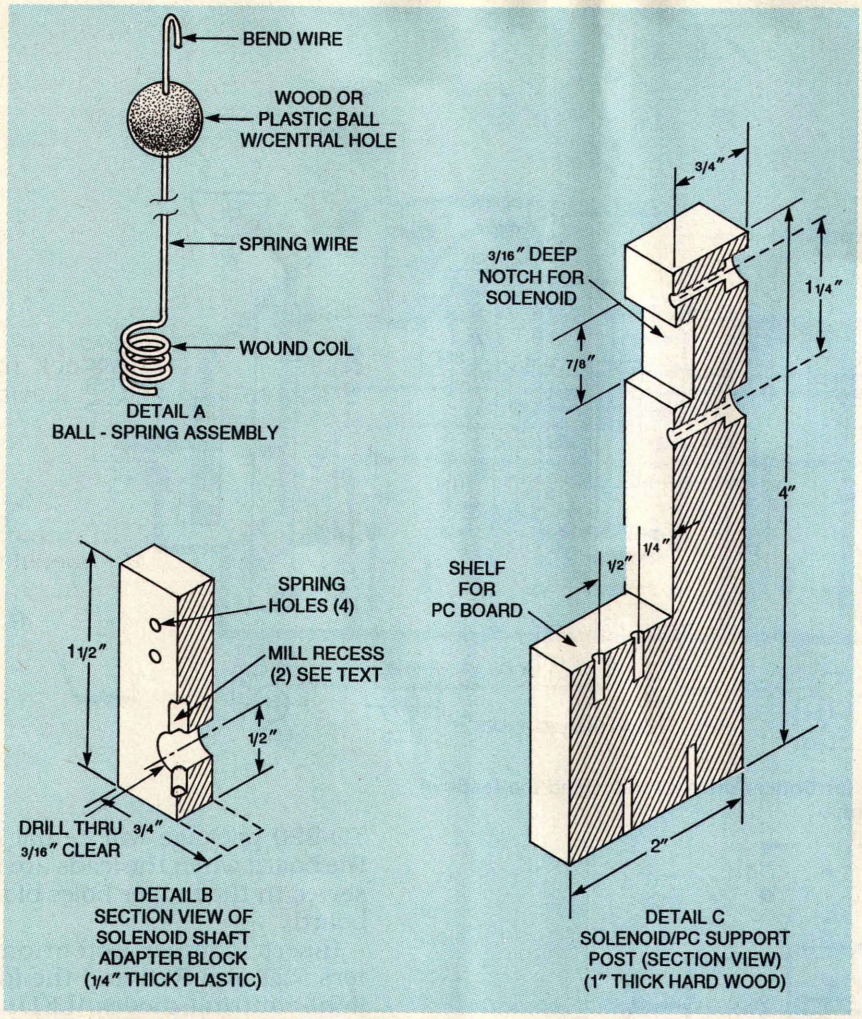


FIG. 5—DETAILS OF MECHANICAL PARTS: ball-spring assembly (Detail A); solenoid shaft adapter block (Detail B); solenoid/PCB support post (Detail C).

D alkaline cells, if you prefer not to run it from an adapter.

Turn on switch S1 to apply power. All of the LEDs should turn on and then go off. Then illumination patterns will be established: LEDs 1 and 4 will turn on every 4 to 10 seconds and continue to repeat that cycle, and LEDs 2 and 3 will turn on every 15 to 25 seconds and repeat that cycle. After you have verified this, turn off switch S1.

Place the rotary solenoid with its shaft side down and find the end of the spring that is coiled around the back end of the shaft within a slotted enclosure. With needle-nose pliers and a small screwdriver, pry up the end of the spring and re-insert it two places to the left (counterclockwise). Releasing the spring tension permits the solenoid to be operated from a 12-volt source.

Strip the insulation back from the ends of the two solenoid wires, insert them in the holes as shown on Fig. 4, and solder them temporarily in position to check the drive circuit's operation.

When S1 is switched back on, the shaft of the solenoid should oscillate back and forth over a limited angular sector. Check to see that a LED lights whenever the shaft oscillates. This response verifies that the circuit is operating properly.

Special mechanical parts

Refer to mechanical detail drawing Fig. 5, Detail A. Securely clamp the ¾-inch diameter wood ball in a vise and carefully drill a hole through its center with a No. 60 drill bit.

Clamp the end of an approximately 15-inch length of 0.028 steel piano wire in a vise and wrap the other end of the wire

PARTS LIST

All resistors are ¼-watt, 10 %

R1, R25—47,000 ohms
R2, R7, R12, R12, R19, R20, R21, R22, R24—1000 ohms
R3, R4, R5, R8, R9, R10. R13, R14, R15, R16, R17, R18—100,000 ohms
R6—180,000 ohms
R11—150,000 ohms
R23—4.700 ohms
R26—2000 ohms
R27, R28—25,000 potentiometer, slide, PC mount, Slide-Trol 112 or equiv.

Capacitors

C1–C5—330μF, 25 VDC, aluminum electrolytic, radial leaded

Semiconductors

D1–D8—1N914/4148 silicon switching diode, 75 PIV
LED1–LED4—light-emitting diode, red, T-1¾ package
Q1—2N2222 silicon transistor, Motorola or equiv.
Q2—IRF9Z20 power MOSFET, N-channel, TO-220 package, International Rectifier or equiv.
IC1—LM324N quad operational amplifier, 14-pin DIP, National Semiconductor or equiv.

Other components:

SOL1—rotary solenoid, Ledex 188687-001 or equivalent.
S1—slide switch, SPST, 5A, PC mount

Miscellaneous: Wood or plastic base (see text); wood ball, ¾ diameter; steel spring wire (0.018 in.), 15 inches long; solenoid/circuit board mounting bracket (see text); 120 VAC to 12 VDC, 1 A, regulated wall-outlet adapter; round or pan head wood screws; insulated hookup wire; solder.

Note: The following options are offered by General Science and Engineering, P.O. Box 447, Rochester, NY 145603, 716-338-7001

- **Printed circuit board—$7.50**
- **Bonker kit including printed circuit board, all electronic components, rotary solenoid, spring wire with coil, and wood sphere—$38**
- **Finished Bonker ready to operate—$89.00**
- **Alternative wood bases and solenoid mounting posts: pine—$9.50; veneer—$12.00; oak—$16.00; ceramic insulator and oak base—$16.00**

Money order, Visa, or Master Card accepted. Add $3.00 S&H. New York State residents add local county sales tax.

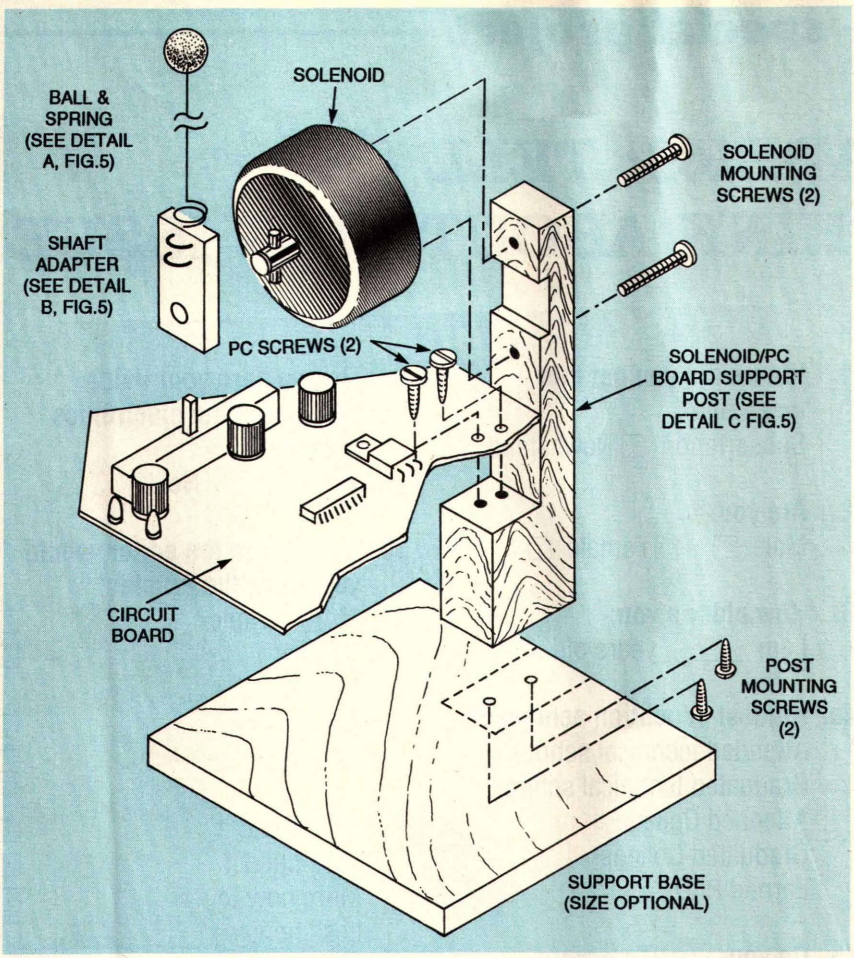

BALL & SPRING (SEE DETAIL A, FIG.5)
SOLENOID
SOLENOID MOUNTING SCREWS (2)
SHAFT ADAPTER (SEE DETAIL B, FIG.5)
PC SCREWS (2)
SOLENOID/PC BOARD SUPPORT POST (SEE DETAIL C FIG.5)
CIRCUIT BOARD
POST MOUNTING SCREWS (2)
SUPPORT BASE (SIZE OPTIONAL)

FIG. 6—ASSEMBLY DIAGRAM: The support base can be round or rectangular provided it is thick enough and has an area larger than about 30 square inches so it will be stable.

about eight times around a ⅛-inch dowel to form a coil spring with the aid of pliers. (Expect the diameter of the coil to expand after releasing tension on it.)

Insert the free end of the spring wire in the hole drilled through the ball, and then bend about ¼-inch of the end of the wire back on itself and push the bent end back into the drilled hole to assure a secure press fit.

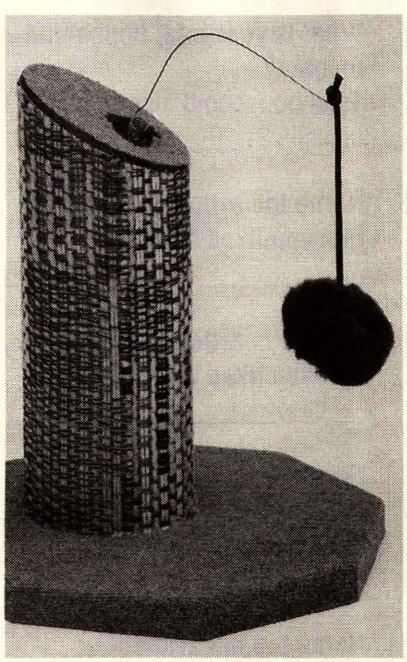
Note: It is important that the ball be fastened securely to the wire so that it will not fly off when the solenoid is oscillating. If you want to paint or spray the ball with bright red or yellow enamel to make it more conspicuous, this a good time to do it.

Refer to Fig. 5, Detail B. Cut a rectangle measuring 1½ × ¾-inch from ¼-inch thick hard plastic and file the edges smooth. Drill a 3/16-inch hole through the block ½-inch in from one end (as shown) so that it can be press fit over the rotary solenoid shaft. Push the block onto the shaft and mark the ends of the cross-pin on the surface of the block.

Remove the block and cut or mill out short slots on both sides of the hole so that the cross pin and shaft will seat securely in the block. With a 1/16-inch diameter bit, drill four small holes in the block in a square pattern, and set it aside.

Refer to Fig. 5, Detail C. A supporting post that is fastened to a base board is suitable for mounting both the solenoid and the apex of the circuit board. The general dimensions for a post are shown in the detail. It is suggested that it be made of wood that is hard enough so that it will not split when drilling the holes in it and fastening the base and circuit board to it.

The general outline of the post can be changed to suit your taste, but it has some critical dimensions: the size and spacing of the drilled and countersunk holes for mounting the solenoid, the spacing between the drilled holes for mounting the circuit board to the shelf, and the width and depth of the notch for accepting the end of the solenoid. You might want to paint or varnish this post before assembling it to a base.



THE BONKER CAN BE BUILT in many different configurations with a choice of base styles and materials. This one is designed to drive cats wild.

Bonker Assembly

Refer to the mechanical assembly drawing Fig. 6. The bonker must have a suitable, sturdy base. This can be cut from wood or plastic in a round square, or rectangular shape but should be large and heavy enough to provide a secure support for the solenoid and circuit board. (A minimum of 40 square inches of material that is at least ¾-inch thick is recommended.) Again, you might want to paint or varnish the base before proceeding.

Drill and countersink two holes near the edge of the base with the same spacing as the matching holes in the base of the support post (Detail C, Fig. 5). Fasten the post to the base

(Continued on page 60)

READERS: TELL US WHAT YOU THINK ABOUT THIS ISSUE

Are you interested in helping us make this magazine as good for you as it can be? Then be one of the first to join the 1994 *Electronics Now Reader Council*. Twice a year you'll be asked to complete a detailed questionnaire. It will tell us about the things in this magazine that are important to you and give us the information we need to make this your best possible reading.

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Thank you, and I am looking forward to hearing from you!

Larry Steckler,
Editor-in-Chief

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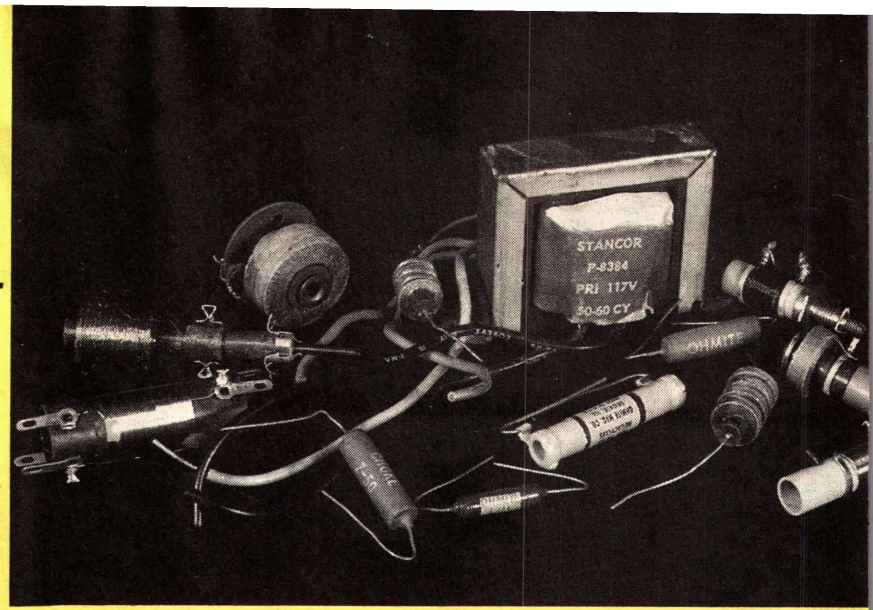
Here's an easy way to test transformer windings, coils, chokes, and motors—almost any device containing a winding.



JUD WILLIAMS, CET

SIMPLE TEST FOR TRANSFORMERS

ONE COMPONENT THAT PRESENTS perplexing troubleshooting problems is the ordinary power transformer. It is particularly difficult to tell if the windings are short-circuited because ohmmeter readouts are rather ambiguous when measuring resistance values less than 1 ohm. When I first started to repair power supplies, I got the idea of bucking an ordinary 6.8-volt filament transformer against the winding of a suspect transformer. (Transformers called *filament* transformer were used to power the heating elements of vacuum receiving tubes known as filaments. These transformers are still widely available.)

I found that when I connected the 6.8-volt secondary of the transformer across (or parallel to) the winding of a transformer under test, the output voltage was approximately the same as the open-circuit voltage of the unloaded filament transformer. If the suspect transformer had a short-circuited winding in it, the voltage would drop to 50% or more. Thus, by placing an AC voltmeter across the winding, I could identify a defective transformer with no trouble. Figure 1 shows my test setup.

I found that a continuity check with an ohmmeter is also necessary to ensure that the winding is not open. When making a continuity test with an ohmmeter, I looked for a very low resistance reading, and made sure that the meter was set to its lowest range. Transformer winding resistance is typically several ohms, depending on the number of turns in the winding. This value depends on the length of wire in the winding, its diameter, and its DC resistance.

Why does this work? An AC inductive impedance is parallel to an unknown reactive element such as a coil or winding. Because the secondary winding of the filament transformer has a relatively low impedance, it should, in most cases, be in parallel with a higher impedance, so the filament transformer will not be loaded down. If the transformer being tested has shorted windings, the impedance will usually be less than the filament transformer impedance. This will result in a lower-than-normal voltage reading.

This test will work for power transformers, as well as relay coils, solenoid coils, chokes, ferroresonant transformers, AC adapters, inverter transformers, electric motors, and fans. Almost any product containing a winding can be tested. Ω

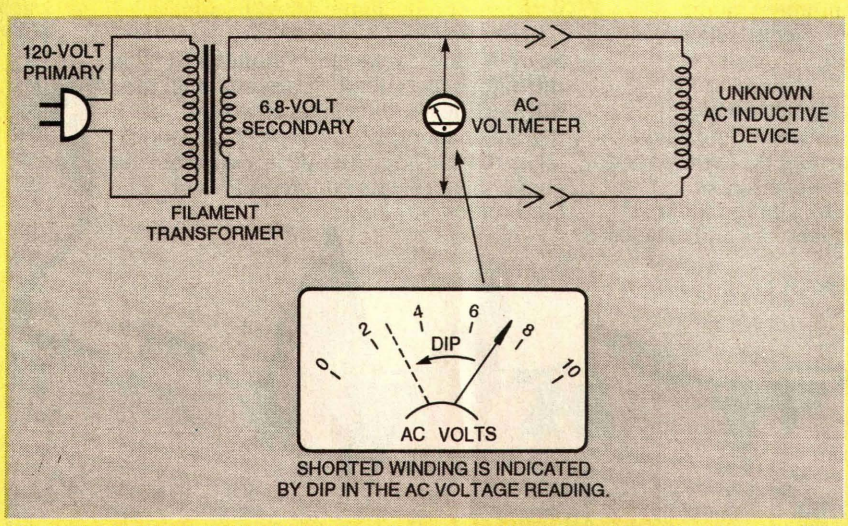
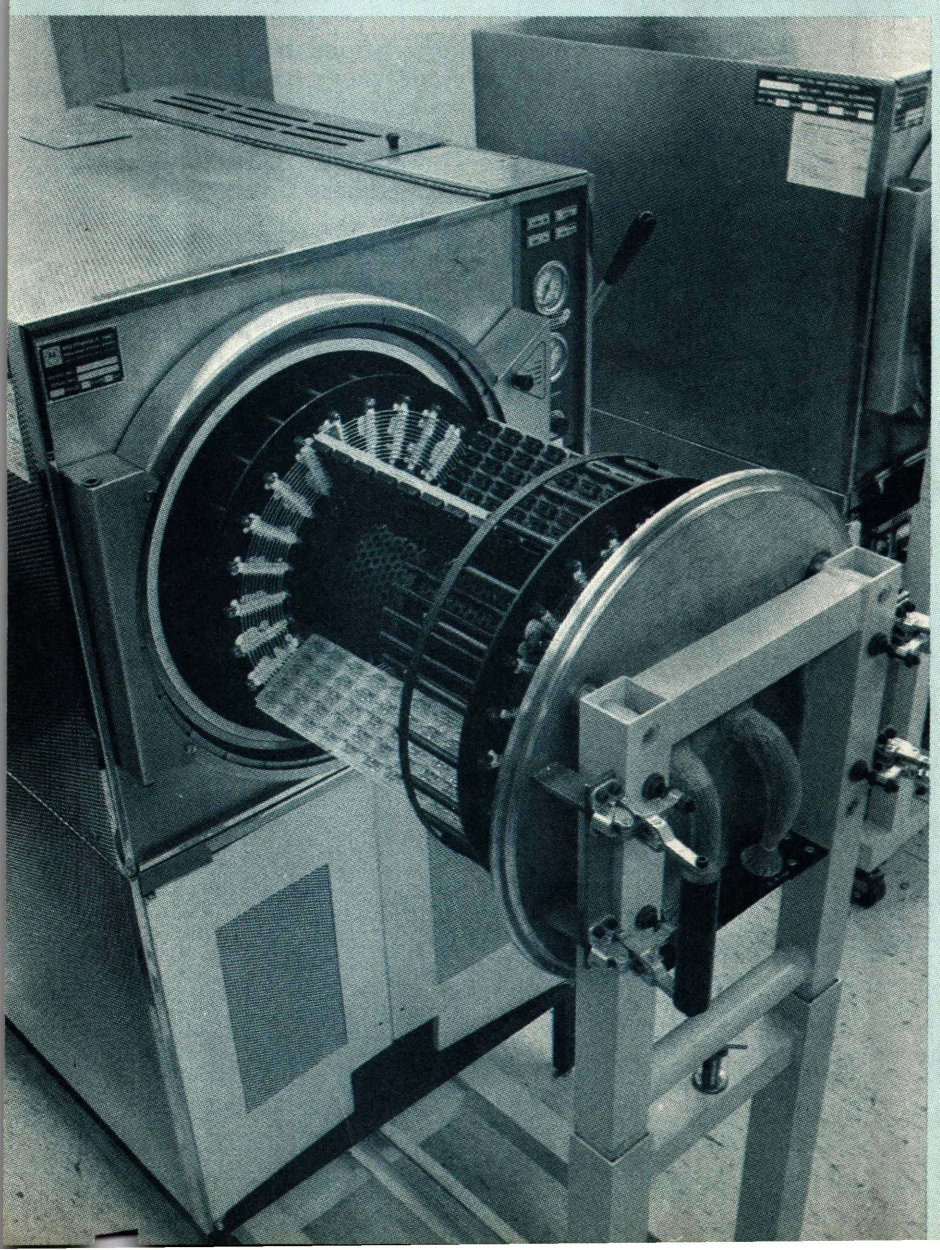


FIG. 1—THIS SIMPLE TEST SETUP makes the testing of any kind of coil or winding easy.

ENVIRONMENTAL SEMICONDUCTOR TESTING

Learn about the testing performed on semiconductor devices to ensure that they work as intended under environmental stresses.

TJ BYERS



A SEMICONDUCTOR DEVICE CAN function perfectly under optimum conditions at room temperature, sea-level air pressure, and low relative humidity but fail when operated in a hostile environment, which can present any combination of physical, chemical and electrical challenges. *Physically hostile* environments exhibit extremes of temperature, air pressure, acceleration, humidity, and radiation. *Chemically hostile* environments include exposure to salt spray, biological fluids, noxious atmospheres, dirt, and chemically active fluids and gases. *Electrically hostile* environments include destructively high voltages and magnetic fields as well as AC, DC, and transient interference over the whole spectrum.

Semiconductor device manufacturers can go a long way in protecting their products from hostile environments by packaging them in hermetically sealed cans or ceramic packages. There is a choice of ceramic DIP (CERDIP) hermetic packages and even more expensive solder-sealed (side-brazed) ceramic packages. But this premium-priced packaging increases the number of manufacturing steps required and raises the unit price of the device.

Military and aerospace standards have long specified metal or ceramic device packaging because it is known that these products will be exposed to greater stresses than comparable consumer or commercial devices. This applies to diodes, transistors, and thyristors as well as logic, memory and microprocessors. In certain instances, semiconductor device failure could result in loss of life in applications such as life support equipment, emergency radios, navigation equipment, and weapons control systems.

Therefore, reliability has been more important than unit price in these applications, and devices intended for those purposes are still more rigorously tested and they receive tests not specified for other devices.

However, as a result of improvements in manufacturing techniques, and favorable indications from years of accumulated reliability data, plastic packaged devices are now performing satisfactorily in applications previously reserved for metal and ceramic-packaged devices. The Department of Defense is trying to reduce the cost of electronics without compromising reliability by turning to the documented internal practices of semiconductor manufacturers for many non-critical applications.

For years U.S. military contracts for electronics equipment of all kinds routinely called for military-spec-semiconductors, regardless of end-use—combat aircraft, ships, or vehicles as well non-combat activities in military bases and depots. However, the NATO-pact countries have generally been more relaxed on this issue when procuring military electronics.

Today, however, the DOD is accepting more commercial equipment for base and depot activities such as telecommunications, electronic test and checkout, and data processing. Commercial equipment such as radios, radar and navigational equipment is purchased for non-combat aircraft, ships and vehicles. While that equipment might have more rugged, military-style packaging and be subjected to relaxed environmental tests, the semiconductors will be commercial products.

Nevertheless, when you buy any semiconductor device these days, you are purchasing a survivor—only the fittest have made it out of the factory. The device might represent only a fraction of its mates that were grown on the same wafer. Regardless of its intended end use, only the healthy products have made it out of the factory door.

If you are an electronics hobbyist or design and build circuits intended to work only under controlled environmental (indoor) conditions, you might not be concerned with environmental testing. However, if you have responsibilities for the design, manufacture, maintainance, or specification of military and aerospace electronics, you are probably familiar with MIL-STD-883, the Military Standard Test Methods and Procedures for Microelectronics.

The "Bible" for all semiconductor device testing, MIL-STD-883 includes 18 different environmental tests. Table 1 lists the environmental tests by method number, and Table 2 lists method numbers for mechanical tests.

Not every semiconductor device manufactured is 100 % tested because its cost would be prohibitive. A sampling of parts "stands in" for its mates; that lot shares the fate of the samples. There is no reason to believe that 100 % testing would yield products that are more reliable than those screened by statistical quality control.

Preliminary electrical tests are performed on special test circuits designed into the wafer. A failure to pass these built-in tests could lead to the rejection of the complete wafer containing hundreds of active discrete or integrated devices.

Dies or chips that will become military-qualified parts are sorted from those that will become commercial parts at the wafer level. Both classes can be further sorted by performance characteristics (such as speed in memories). The slowest devices in any lot sell for less than the fastest devices.

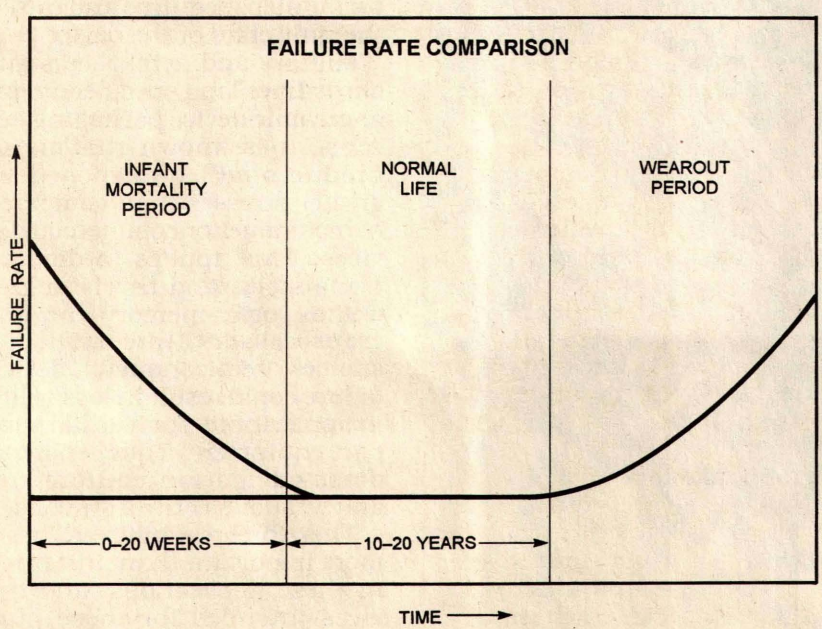


Fig. 1—BATHTUB HAZARD RATE CURVE for failure rate comparison in reliability testing of semiconductor devices

TABLE 1
MIL-STD-883 ENVIRONMENTAL TESTS FOR SEMICONDUCTORS

Method Number	Test Name
1001	Barometric pressure (altitude operation)
1002	Immersion
1003	Insulation resistance
1004	Moisture resistance
1005	Steady state life
1006	Intermittent life
1007	Accelerated life
1008	High-temperature storage
1009	Salt atmosphere (corrosion)
1010	Temperature cycling
1011	Thermal shock
1012	Thermal characteristics
1013	Dew point
1014	Seal
1015	Burn-in test
1016	Life/reliability charaterization tests
1017	Neutron irradiation
1018	Internal water-vapor content

Dies or chips packaged in plastic are not be subjected to the same environmental stresses (particularly temperature extremes) as those packaged in hermetically sealed metal cans or ceramic packages. Regardless of the device's eventual application or packaging, its electrical parameters are measured and recorded for reference before it is subjected to the rigors of environmental testing.

At the completion of the environmental testing steps, the electrical parameters are measured again, and any changes in characteristics are noted. That data determines whether the device is acceptable for sale in any category or must be rejected as a failure.

AMBIENT TEMPERATURES inside a chamber at Motorola Semiconductor typically range from -65°C to 150°C.

Classes of environmental tests

The environmental tests given to any device depend on its type and application. Most of the world's semiconductor manufacturers subject their products to tests based directly or indirectly on the methods specified in MIL-STD-883. Semiconductor devices procured by the Department of Defense must be tested in accordance with those provisions, but commercial/consumer products might be given tests that are relaxed versions of those tests.

Many people assume that the military standard tests for semiconductors are prepared by Pentagon bureaucrats and imposed upon the semiconductor manufacturers. But they are actually the result of a joint efforts between the Department of Defense and the manufacturers who have an opportunity to express their views on what is feasible and wht is not.

The military standards are the result of considerable investment of time and money over many years by all participants. Those standards and specifications were far more important years ago when the DOD was the largest semiconductor customer. However, the standards have survived the massive shift in customer base from defense to commercial over the past 20 years, due more to the rapid growth in the commercial spending rather than a decline in defense spending.

As Table 1 shows, the range of environmental and mechanical tests based on MIL-STD-883 is wide and varied. Most testing is done on a sampled basis. Some tests are so potentially destructive that even if the device passed, it might be fatally weakened by the test.

It is common industry practice to select a random sample of devices from a larger lot, usually from about seven to a hundred, for testing. These devices are then divided into groups of one device or more, and each group is subjected to a different test routine. At the end of the test program, the parts are evaluated for performance. From these results, the general health of the untested devices in the lot is determined by statistical analysis.

Chambers of horrors

Most environmental tests take place in chambers that are capable of testing semiconductors under environmental conditions that exceed those that would normally be encounterd in the laboratory. Temperature, humidity, and air pressure, for example, can be cycled over wide limits and controlled within chambers.

Most test chambers are designed for a specific test such as temperature or pressure cycling. A temperature chamber with a humidifier permits the simulation of tropical conditions, and one with a salt mist injector can reproduce conditions on or near the ocean. A pressure chamber permits the simulation of air pressures many times normal that would be encountered in the depths of sea as well as those near zero to simulate outer space.

Thermal stress

Thermal stress is the most damaging environmental influence on semiconductor devices. Extremes in operating and ambient storage temperatures place more strain on an electronic component than all of the other environmental factors combined.

Thermal stress testing is classified into three basic categories: high-temperature storage, temperature cycling, and thermal shock. Within each category there are subsets of test conditions that can be tailored for different kinds of devices.

High-temperature storage

The high-temperature storage test (stabilization bake) (Method 1008) tests the effect of elevated temperature on a semiconductor device with no power applied. A temperature-controlled oven is the only equipment required to perform this test. The parts to be tested are placed in the chamber, and the temperature is increased to the required storage temperature.

The actual storage temperature depends on the intended application of the part being tested. Temperatures range from 75°C to 400°C (167°F to 752°F). Military and aerospace devices are, as you might expect, tested at higher temperatures than their commercial counterparts. Devices with plastic packages are generally tested at 150°C (302°F).

The samples are kept at the storage temperature for a specified time period that can range from 24 to 1000 hours. The parts are then removed from the chamber, allowed to cool to room temperature, and tested for electrical performance.

Some form of high-temperature storage is frequently imposed as preconditioning treatment for other tests. Solvents left over from plastic injection molding and subsequent cleaning can cause erratic performance. Even brief high-temperature cycling can drive off those contaminants, stabilizing the device parameters.

Temperature cycling

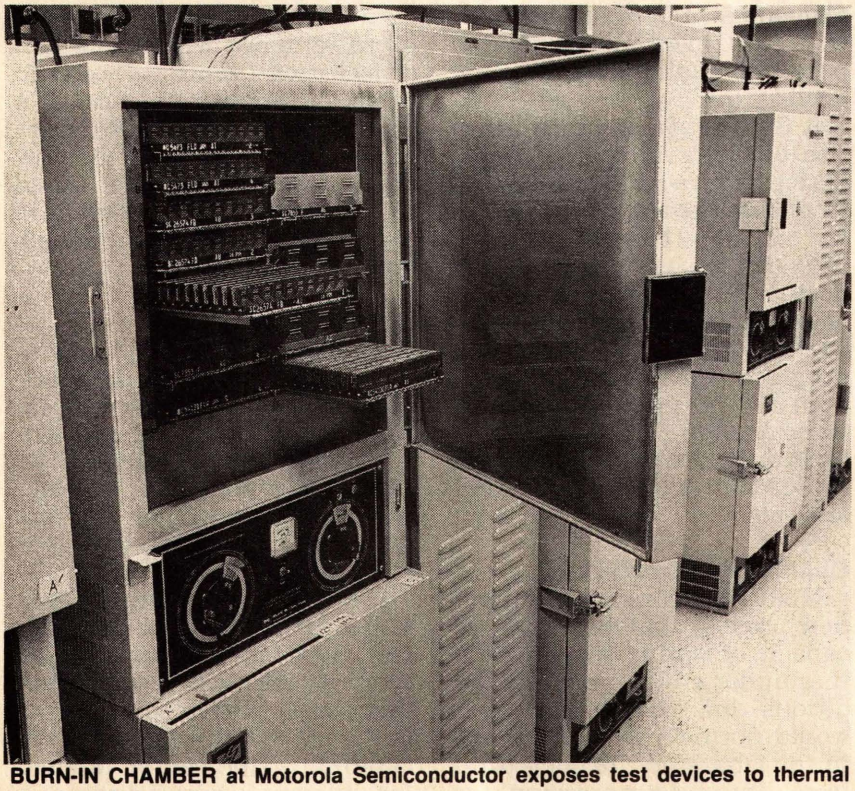
Temperature cycling (Method 1010) also tests the ability of a component to withstand alternate exposure to extremes of heat and cold. Devices intended for automotive applications, for example, must survive repeated cycles of high and low temperature extremes.

Any permanent changes in a semiconductor device's operating characteristics caused by temperature cycling are usually the result of mechanical strains set up between materials. This damage can take many forms: cracking and crazing of the molding compounds, opened seams and seals, insulation failure, and the separation of the lead wires from the semiconductor die or chip.

Temperature cycling is done in a chamber or oven whose temperature can be cycled and controlled between specified temperature extremes. Alternatively, the test can be performed in two separate chambers: one to obtain the high temperature and the other to obtain the low temperature.

For military-qualified devices, these extremes are typically −65°C to 150deC, (-85°F to 302°F) air-to-air for 10 cycles. For commercial/consumer (including automotive) devices, they are typically 0°C to 100°C (32°F to 212°F. Forced air circulated within the chamber minimizes the thermal layering within chambers that could invalidate the results.

In the standard procedure, the devices to be tested are put in the cold chamber first and allowed to stabilize for a minimum of 15 minutes. Then they are transferred to the hot chamber for 15 minutes. Together, these exposures make up one temperature cycle, and ten cycles are required. No more than a five minutes delay at room temperature (25°C) is permitted between the time the parts are transitioned from one extreme to the other.



BURN-IN CHAMBER at Motorola Semiconductor exposes test devices to thermal stress under power.

Thermal shock

Thermal shock (Method 1011) is the most demanding thermal stress test. It is a more severe version of temperature cycling. A liquid replaces the air as the heat transfer medium for temperature cycling in this test. Because a liquid transfers heat more efficiently than a gas (air), the internal temperature of the device being tested is changed more rapidly.

A temperature-controlled bath containing a liquid, typically water, suitable for heat transfer over the specified range is required for this test. The temperature limits for thermal shock are often the same as those for temperature cycling.

Chlorofluorocarbon (CFC) compounds (e.g., Freon) have been used for mil spec testing, but substitutes may be required because of possible damage to the ozone layer caused by the release of those compounds to atmosphere.

Unlike temperature cycling, a thermal shock cycle begins with the immersion of the sample in the heated liquid. After five minutes at that temperature, the component is quickly transferred to the cold solution. Then after another five minutes at low temperature, the cycle is complete and another cycle is started immediately. Fifteen complete cycles are required to complete the test, and the time taken to transfer the part from the hot to the cold bath must not exceed 10 seconds.

Moisture resistance

The moisture resistance test (Method 1004) is similar to the thermal shock test (Method 1011). It is performed to evaluate the ability of a device to withstand the deteriorative effects of high humidity and heat. The damage caused by moisture includes absorption of moisture by insulating materials, surface wetting, and metal corrosion.

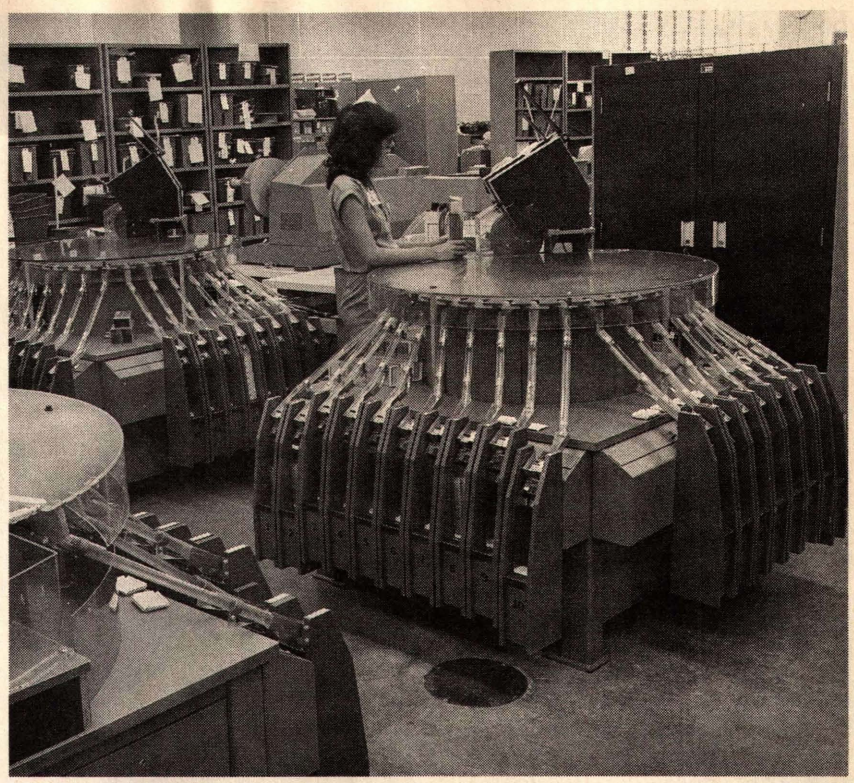
This test is performed in a temperature-controlled chamber with a humidifier capable of creating relative humidity conditions of 85 % or more. Prior to the test, a bias voltage equal to the maximum operating voltage of the device is applied between its power terminals.

A reverse bias voltage equal to their breakdown voltages is applied to diodes, transistors, and thyristors, and a voltage equal to the normal supply voltage is applied to digital and analog integrated circuits.

Salt atmosphere

The salt atmosphere (corrosion) or salt spray test (Method 1009) determine the device's resistance to the ingress of salt solution and to corrosion on exposed and interior surfaces. More rigorous than the moisture resistance test, it simulates conditions found at the shore or aboard a ship at sea.

The devices to be tested are suspended for 24 hours in a mist of 20% sodium chloride solution at 35°C so that liquid cannot collect on them. Air flow within the chamber is adjusted so that salt deposits accumulate at the rate of 10,000 to 50,000 milligrams per square meter per day.



POST BURN-IN TEST and evaluation with automated test equipment.

At the conclusion of the test, the samples are rinsed in warm water and gently scrubbed to remove salt deposits. The devices are then given a visual examination under a magnifying lens for signs of deteriorization such as lead metal corrosion or surface contamination.

Hazard rate curve

High infant mortality has been an ongoing problem for the semiconductor industry since the early days of transistors. A device might pass all of its electrical, environmental and mechanical tests and for various reasons fail after hours or days of service.

Theory and experience have shown that the failure rate for semiconductor devices normally follows a predictable curve—the famous *bathtub hazard rate curve* (see Fig.1). This curve is normally split into three regions for reliability analysis:

1. *Infant mortality period* is a region of high early life failures normally related to manufacturing defects.
2. *Normal life* is a region of relatively stable performance representing the useful life of the device. A low level of random failures can occur in this region of the curve.
3. *Wearout period* is the region following normal life where failure rate will increase rapidly due to wear out.

The infant mortality period is typically a few weeks while stable or normal life could be 20 years or more. Most semiconductor circuits will have been replaced with new designs and technologies before the wearout period is reached.

Many reasons have been advanced to account for infant mortality. Typical reasons advanced include materials and assembly defects, marginal design of the device, or faulty setting of test guardbands. Many of these failures can be detected during the manufacturer's quality testing process.

However, device mortality after it has been operating for weeks in a circuit is generally caused by deviations in the manufacturing process or the inadvertent application of overvoltages. These failures cost the industry millions of dollars in lost production and reflect

poorly on the manufacturer, who must bear the burden of replacements.

Static burn-in

There is ample evidence that infant mortality can be reduced to less than 1% with a test procedure called *burn-in* (Method 1015). The device is placed in an chamber that stresses both the device's electrical and thermal limits. Only those components that survive this ordeal live to become useful products.

Burn-in is performed on the test device at a minimum ambient temperature of 125°C (257°F) with power applied. For military compliant products, a 100 % test is given for 160 hours. However, for commercial products the duration of that test might only be 16 hours—if it is done at all. The high ambient temperature is maintained during burn-in by thermostatic control of the chamber. A means is provided for transmitting power to the devices inside the chamber.

The power simulates electrical and signal conditions that the device is expected to experience in normal operation. Five methods for applying the power are in common use. The first three methods, known as *static burn-in*, call for the application of DC power only.

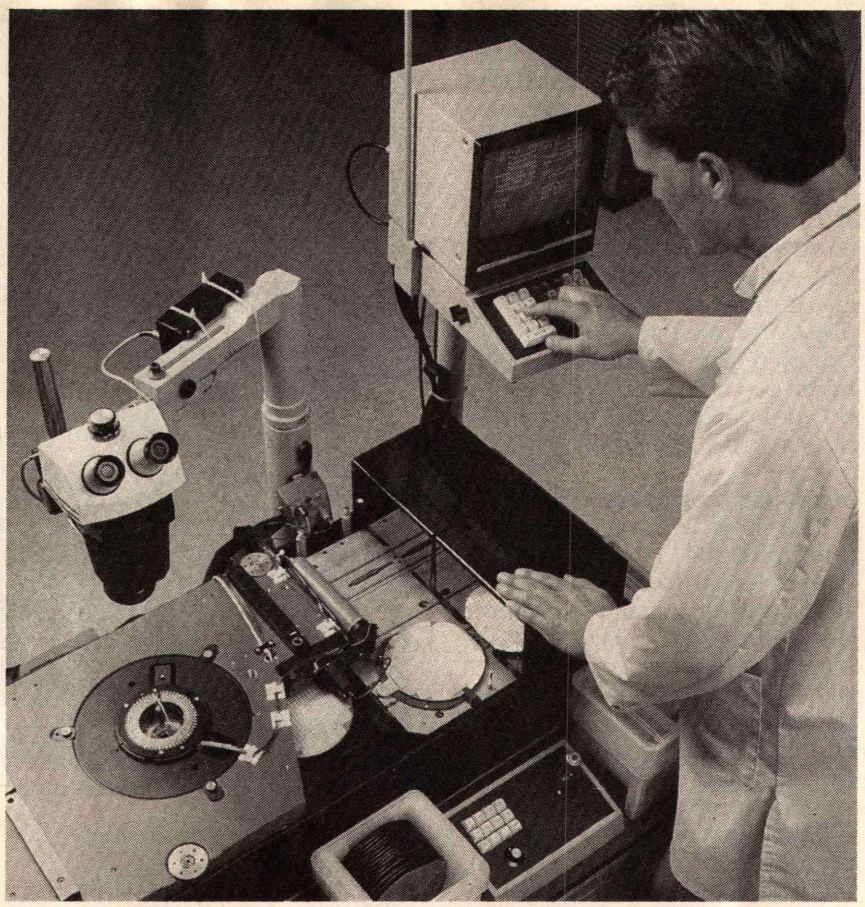
Dynamic burn-in

Dynamic burn-in is specified when simple steady-state test conditions are insufficient to guarantee the reliability of the device for critical applications, such as those that would be encountered in spacecraft. In this test, AC signals are applied to the inputs of the device under test to simulate actual circuit operating conditions.

After burn-in, all sample devices receive a 100% functional screening at 100° C. Because failures among burned-in devices can be catastrophic, a continuity check is usually given to the parts before testing to prevent short-circuited devices from damaging the test circuit.

Mechanical tests

The MIL-STD 883 includes the mechanical tests listed in Table 2. These include methods for testing constant acceleration, mechanical shock, and vibration fatigue, noise, and variable frequency. A constant acceleration test might require that the device be subjected to 30 kg for 1 minute on each axis to test the internal connections of the device.



ELECTRICAL TESTS are made on a semiconductor device wafer to eliminate faulty units prior to environmental testing.

TABLE 2
MIL-STD-883 MECHANICAL TESTS FOR SEMICONDUCTORS

Method Number	Test Name
2001	Constant acceleration
2002	Mechanical shock
2005	Vibration fatigue
2006	Vibration noise
2007	Vibration, variable frequency
2013	Radiography
2020	Particle impact noise detection test

Other tests

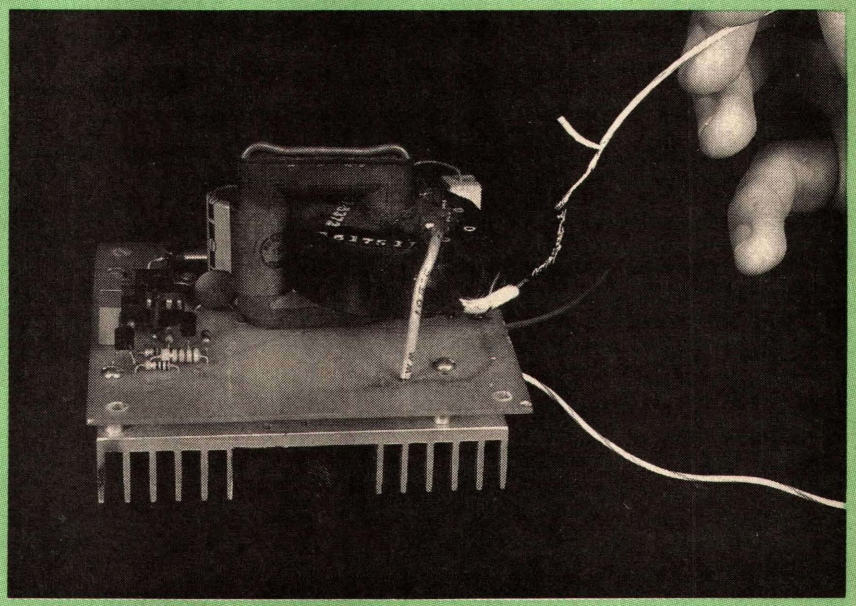
The procedure for obtaining qualification for a semiconductor device in compliance with MIL-M-38510 is costly and time consuming. When complete, a so-called JAN (Joint Army Navy) "slash sheet" is issued by the Defense Electronics Supply Center (DESC). There are two product assurance classes available for M38510 products (Class S and B). The IC manufacturers qualified to supply product to a particular M38510 slash sheet are identified in the Qualified Products List (QPL) issued by DESC.

However, if a military/aerospace contractor wishes to use a part that does not have a JAN slash sheet, the product can be processed to MIL-STD-883, Class B, Method 5004, and it will be electrically tested 100% to the manufacturer's data sheets. These products are identified by the /883 suffix on the part number.

Continued on page 89

BRENT C. TURNER

BUILD A SOLID STATE TESLA COIL



Build a solid-state version of Tesla's famous coil. It is easier to build and safer to operate.

NICOLA TESLA'S COIL IS ALIVE AND well today, living in school labs and hobbyist's workshops as a tool for learning and experimentation. The classical air-core transformer with a spark gap and capacitor produces a high voltage at high frequencies. However, new designs of that concept based on solid-state components and improved transformers make the construction of a Tesla coil easier and safer.

When Tesla devised his coil, the spark gap oscillator was the only practical method for generating the necessary radio frequency current across a transformer primary that would result in high-voltage at the secondary winding. However, the drawback of the classical Tesla coil is the ability of its high-voltage transformer to impart a life-threatening electrical shock to anyone experimenting with it.

Fortunately, high-voltage power transistors designed and built to meet the demand from switchmode power supply manufacturers are now readily available. Some power MOSFETs are capable of switching up to 1500 volts safely. Moreover, the task of building a suitable transformer has been simplified with the development of ferrite core materials that permit transformers to be made smaller and lighter and confine their magnetic fields.

How the Tesla coil works

The voltage output of a classical Tesla coil's secondary, a series-resonant circuit, is produced by oscillations in the secondary winding, as shown in Fig. 1. The Q or figure of merit for a resonant circuit and the applied frequency determine the voltage developed across the inductor.

If a voltage generated at the resonant frequency of the Tesla coil is coupled to its secondary, a high voltage will be produced. In the classical Tesla coil, the primary side of the transformer is fed by a spark-gap oscillator. The capacitor and primary inductance determine its operating frequency. An electromagnetic field from the primary winding couples the energy into the secondary system.

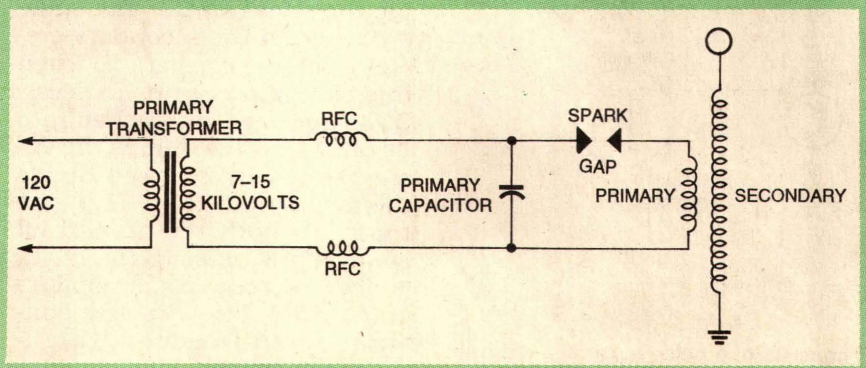


FIG. 1—IN A TESLA COIL, the voltage is produced by resonant oscillations created in a secondary winding.

This original design works well, but it is inefficient; only a fraction of the primary winding's magnetic field is effective in inducing energy into the secondary. This inefficiency is caused, in part, by the expansion of the primary magnetic field. It was seen that if this field could be confined to a smaller volume, the system would be more efficient.

Ferrite transformer core materials make it possible to confine magnetic fields. Various

powdered compositions of ferric oxide and other metals such as nickel or cobalt are compressed and sintered to form solid cores. Their high resistance makes eddy current losses very low at high frequencies, and coupling efficiency is improved.

The operating principle of the primary system in the solid-state coil design discussed in this article differs from the principle of the classical spark-gap design. If a spike of energy is applied, the coil responds with an oscillating burst that decays with time, analogous to the ringing of a bell when struck by the clapper.

If there is no instant damping of the ringing, it will occur at the natural resonant frequency of the coil. A higher voltage output will be produced by a phenomenon known as *Q factor multiplication.*

The solid-state Tesla coil includes a stock, off-the-shelf, high-frequency pulse transformer. It is essentially the same as the transformer that you will find in the high-voltage generation circuit of a standard television set.

The coil circuit

Refer to Fig. 2. The Tesla circuit consists of a pulse generator, a driver circuit, and a high-voltage transformer. The pulse generator, a 555 timer (IC1), is organized to run in its astable mode to generate a continuous pulse train. Resistors R1 and R2 determine the time duration that the output at pin 3 is off, while R3 and R4 along with R1 and R2 determine the on time. Inductor L1 and regulator IC2 provide a clean, stable power source for the timer.

Transistor Q1 acts as a buffer, effectively isolating IC1 from the highly capacitive load present on the gate of Q3. Resistor R6 determines the rise time based on the time constant developed by R6 and the inherent gate capacitance of Q3. Resistor R8 limits current so that excessive current will not damage T1's primary winding. Capacitor C5 absorbs some of the back EMF generated in T1's primary. Another function of C5 is to provide an extra kick to drive Q3 to an on state.

The pulse waveform from IC1 is applied to Q1, which provides the high current necessary to offset the high capacitance of Q3. When Q3 starts to conduct, current flows through T1's primary, building a magnetic field in the core. After a short time interval, the core saturates, preventing any further generation of magnetic flux. Prior to this, Q3 is switched off, causing the magnetic field to collapse and producing a sharp voltage spike in both windings.

Capacitor C5 partially absorbs the primary EMF, reducing the stress on Q3. The spike produced in the secondary creates a ringing oscillation. When this oscillation begins to decay, Q3 is once again switched into its on state. This dumps the energy stored in C5, and builds the magnetic field in T1. If the timing of both the on and off states of the pulse train are adjusted correctly, the secondary of T1 produces a nearly constant, high-frequency, high-voltage current.

(Continued on page 68)

PARTS LIST

All resistors are ¼-watt, 5%, unless noted.

R1—7500 ohms
R2—10,000 ohms, potentiometer
R3, R6, R9—10 ohms
R4—5000 ohms, potentiometer
R5—180 ohms
R7—180 ohms
R8—150 ohms, ½-watt
R10—1 ohm, 5 watts

Capacitors

C1—220 µF, 25 volts, electrolytic
C2—0.0047 µF, 50 volts, Polyester
C3—0.05 µF, 50 volts, Polyester
C4—0.01 µF, 1200 volts, Polyester

Semiconductors

IC1—NE555 timer
IC2—LM7809, +9-volt regulator
Q1, Q2—2N2222 NPN transistor
Q3—SSM5N55 FET transistor (Samsung or equivalent)

Other components

L1—100 µH choke (Radio Shack No. 273-102 or equivalent)
T1—Flyback transformer (Penn-Tran No. 1-017-5372—or equivalent, provided that the high-voltage rectifier is not embedded within the transformer)

Miscellaneous: Heatsink for Q3, eight-pin socket for IC1, wire, high-voltage wire, perforated construction board.

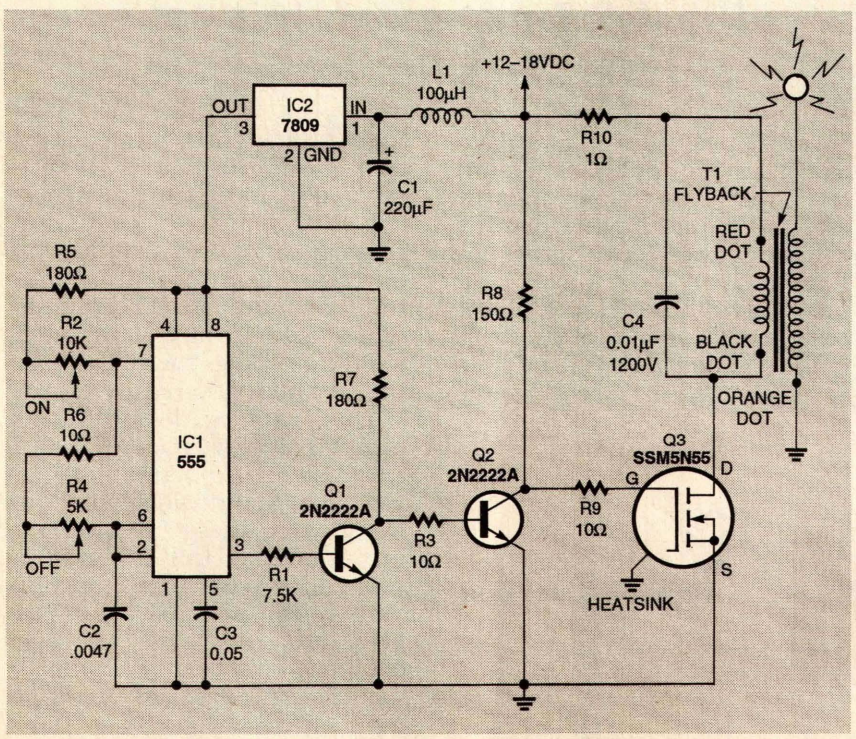
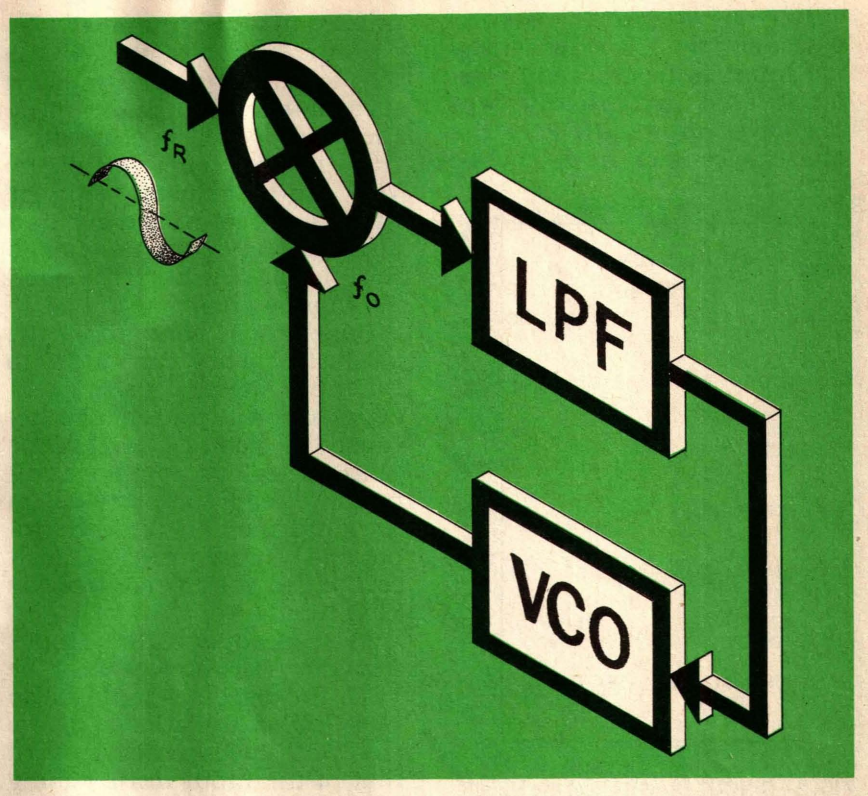


FIG. 2—THE SOLID-STATE TESLA CIRCUIT consists of a pulse generator, a driver circuit, and a high-voltage transformer. The 555 timer (IC1) runs in its astable mode, producing a continuous pulse train.

RAY MARSTON



PHASE-LOCKED LOOPS

Learn more about designing with phase-locked loop circuits in this continuation of last month's article

THIS IS THE THIRD ARTICLE IN A SERIES on phase-locked loop and related circuits. It focuses on the monolithic NE565 phase-locked loop and the NE566 function generator, both prime sourced by Philips (Signetics) but alternate sourced by at least four other multinational suppliers. The electrical characteristics of these two PLL ICs are described, and their block diagrams are presented. Circuit schematics based on these devices are included for learning and experimentation.

The last two articles in this series explained the basic operating principles of the phase-locked loop and examined applications for the popular CD4046B PLL IC.

The NE565 PLL IC

The NE565 is a general purpose monolithic PLL used in circuits for frequency-shift keying (FSK), telemetry receivers, tone decoders, and FM discriminators, to mention just a few. Figure 1 shows the principal functional blocks of the NE565: phase detector (comparator), amplifier, stable voltage control oscillator (VCO), and low-pass filter. The self-contained adaptable filter and demodulator cover a frequency range of 0.001 Hz to 500 kHz.

The center frequency of the NE565 is determined by the free-running frequency of the VCO. This frequency can be adjusted externally with a resistor or capacitor. The low-pass filter, which determines the capture characteristics of the loop, is formed by an internal resistor and an external capacitor. Figure 2 is the pinout diagram of the most popular plastic, 14-pin DIP package for the NE565.

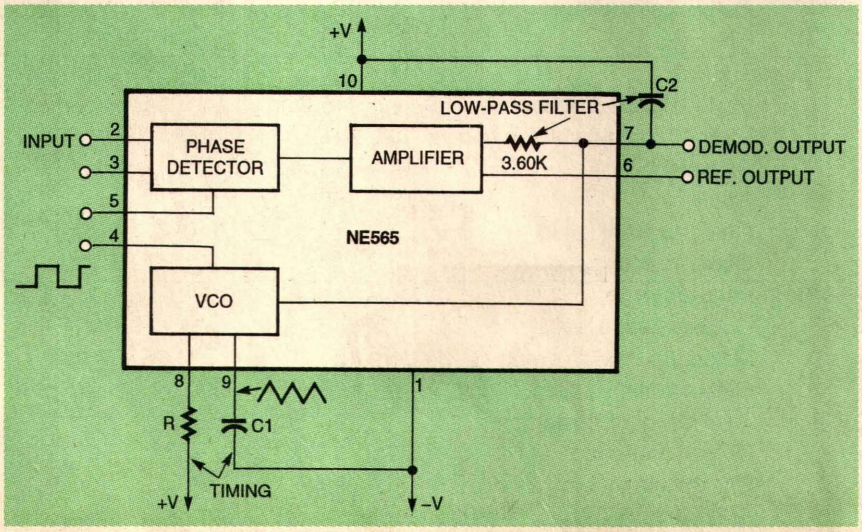


FIG. 1—BLOCK DIAGRAM OF THE NE565 phase-locked loop IC.

The NE565 is not as versatile as the CD4046B because the voltage control input pin of its VCO section is permanently tied to the amplifier output through the internal 3.6-kilohm filter resistor (see Fig. 1). As a result, its VCO can't function separately from the rest of the device. While the NE565 works well in many of the same applications as the CD4046B, unlike that PLL device, it is not recommended as a general-purpose signal generator.

Figure 3 is the the schematic for an NE565 with external components organized as a signal tracker or FM demodulator. The PLL is powered by a split 12-

volt (+6-volt and −6-volt) power supply. The external signal input to be tracked or demodulated is typically connected to input pin 2 of the phase detector of the PLL, while unused pin 3 is grounded.

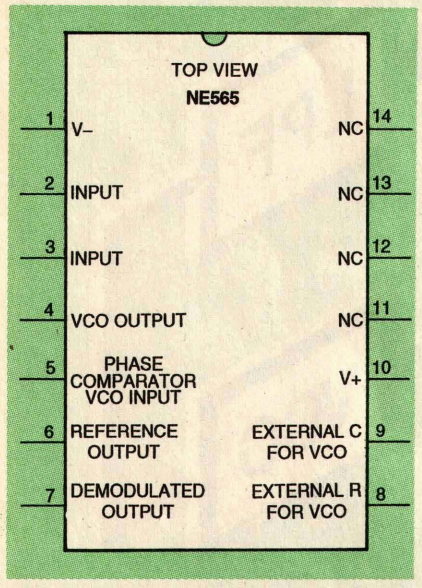


FIG. 2—PINOUT DIAGRAM of the NE565.

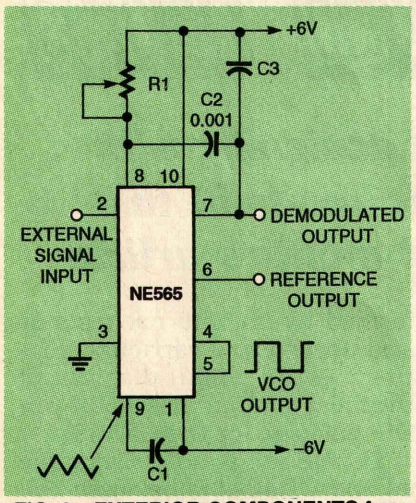


FIG. 3—EXTERIOR COMPONENTS for a signal trackerand FM-demodulator.

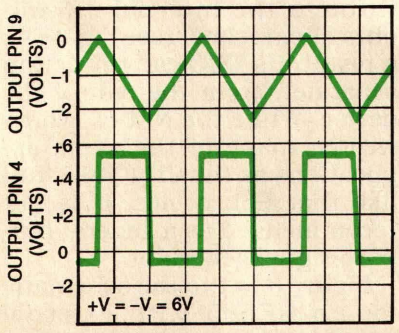


FIG. 4—VCO OUTPUT WAVEFORMS for the NE565 with a plus and minus 6-volt power supply.

Output pin 4 of the VCO is tied to pin 5, the phase detector's input terminal, to complete the phase-locked loop. The free-running frequency (f_O) of the VCO can be adjusted with the RC network connected to pins 8 and 9 so that it corresponds to the mid-range value of the external input signal.

Under those conditions, the VCO's frequency can "lock" to the input signal. This frequency lock condition occurs because the mean DC level of the phase detector's amplified output is directly proportional to the difference between the input and VCO frequencies, and it can act to voltage control the VCO input.

As a consequence, if the input frequency rises above that of the VCO, the detector's output also rises and automatically drives the VCO's frequency toward that of the input until locking occurs.

The single-pole loop filter formed by capacitor C3 (between pins 7 and 10) and the internal 3.6-kilohm resistor at pin 7 causes a short time delay. Therefore, if the input signal is noisy, has jitter, or is frequency modulated (FM), the VCO locks to the *mean* frequency of the input signal and generates a "clean" output at pin 4 or 5. This produces a demodulated FM output at pin 7. The 0.001 µF capacitor (C2) connected between pins 7 and 8 assures circuit stability.

NE565 characteristics

Table 1 summarizes the leading characteristics of the NE565. The IC is normally configured with a split (positive and negative) power supply, which must be between ± 6 and ± 12 volts, but it can also be powered by a single-ended +12 to +24-volt supply.

The phase detector section of the IC has a typical input impedance of 10 kilohms on each terminal. The IC can lock and track to input impedance of 10 kilohms on each terminal, and lock and track to input signals with amplitudes as low as 1 mil-

TABLE 1—ELECTRICAL CHARACTERISTICS OF THE NE565

Parameter	Min	Typ	Max	Unit
Supply voltage	±6		±12	V
Input impedance	5	10		kΩ
Input level for tracking	10			mVRMS
VCO Characteristics				
Center frequency		500		kHz
Drift with temperature		300		ppm/°C
Drift with supply voltage		0.2	1.5	%/V
Triangle wave				
Output voltage level	1.9	2.4	3	Vp-p
Linearity		0.5		%
Square wave				
Logic "1" output voltage	+4.9	+5.2		V
Logic "0" output voltage		-0.2	+0.2	V
Rise time		20		ns
Fall time		50		ns
Output current (sink)	0.6	1		mA
Output current (source)	5	10		mA
Demodulated output				
Output voltage level	4.0	4.5	5.0	V
Maximum voltage swing		2		Vp-p
Output voltage swing		200	300	mVp-p
Total harmonic distortion		0.4	1.5	%
Output impedance		3.6		kΩ
Offset voltage (pins 6 to 7)		50	200	mV
AM rejection			40	dB

livolt RMS. Normally, input signals should be AC coupled, but they can be DC coupled if the DC resistances seen from pins 2 and 3 are equal and there is no DC voltage difference between those pins.

The high stability of the NE565's VCO can be seen in its typical drift with temperature specification of 300 ppm/°C and its typical drift with supply voltage specification is 0.2% per volt when the supply voltage is ± 6 to ± 7 volts. Both of these values are measured at f_o.

The VCO provides well formed, TTL-compatible square waves and triangle waves, as shown in Fig. 4. Those waveforms were obtained with the IC powered by a split 12-volt supply. The square waves, with typical rise and fall times of 20 and 50 nanoseconds, respectively, appear at pin 4, and highly linear triangle waves appear at pin 9 of the VCO.

The VCO's free-running frequency (f_o) is set by trimmer potentiometer R3 in series with the +6-volt power source between pins 8 and 10 and by capacitor C1 in series with the −6-volt power source between pins 9 and 1. That frequency in kilohertz can be calculated as:

$f_o = 1.2/(4\ RC)$

where R is in kilohms and C is in micofarads.

Resistor R3 can have any value between 2 and 20 kilohms, but the optimum value is about 5 kilohms. Capacitor C1 can have any value. Normally, the NE565 will phase-lock to any input signal frequency that is within the range of plus or minus 60% of the f_o value. This is known as the circuit's *lock range*.

The output section of the IC yields a demodulated output at pin 7, and pin 6 gives a DC reference voltage that is close to the DC potential of pin 7. If a resistor is placed between pins 6 and 7, the gain of the IC's output stage can be reduced with with little change in the DC voltage level of the output. This allows the lock range to be decreased to a value as low as 20% of f_o, with little change in the f_o value.

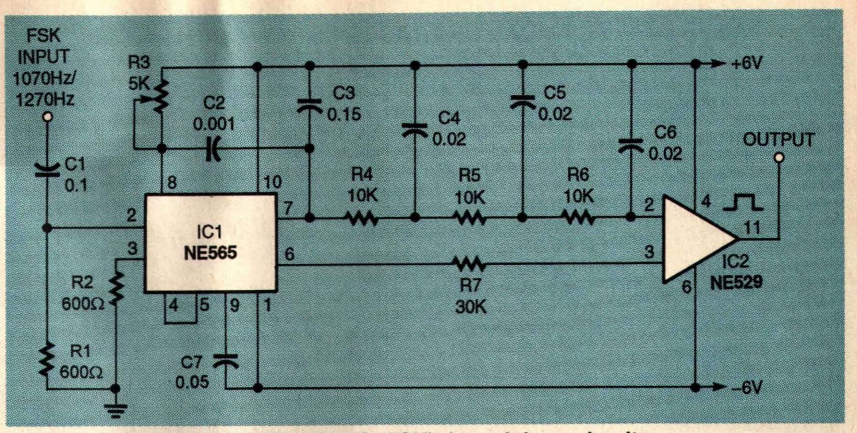


FIG. 5—FREQUENCY SHIFT KEYING (FSK) demodulator circuit.

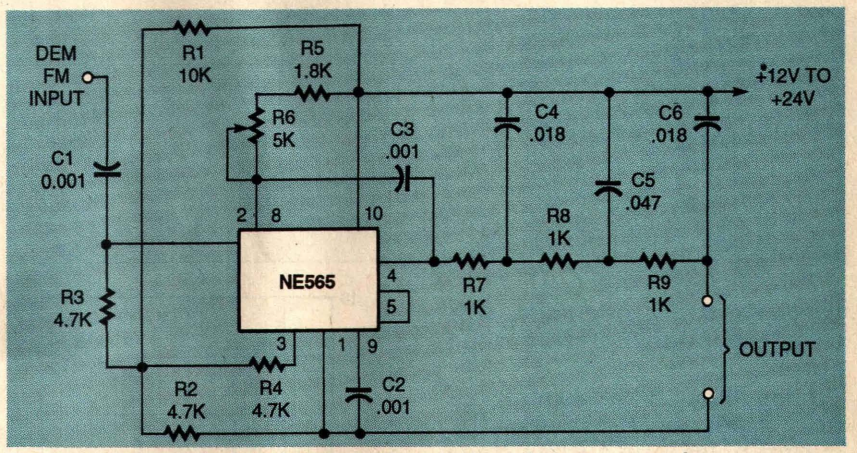


FIG. 6—60 kHz FM DEMODULATOR with a single-ended power supply.

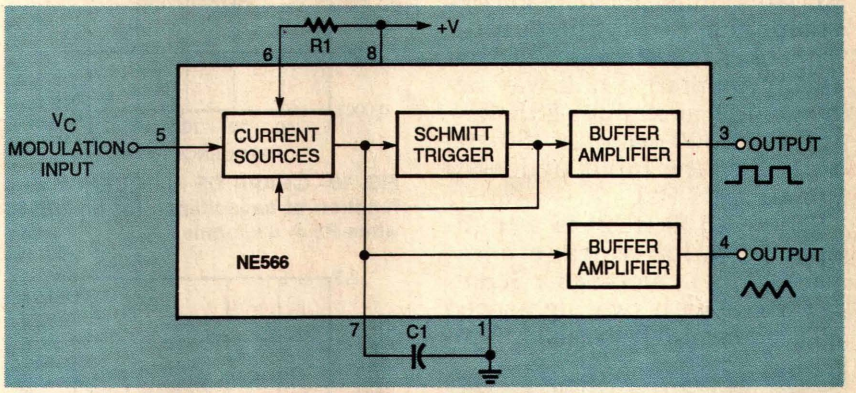


FIG. 7—FUNCTIONAL BLOCK DIAGRAM OF THE NE566 function generator.

FSK demodulator

Frequency shift keying (FSK) is widely accepted in digital communications systems. The transmitter generates a continuous two-tone carrier signal from binary signals with a *mark* or logic 1 state represented by one tone and the *space* or logic 0 state represented by another tone. An FSK decoder in the receiver converts the two-tone carrier back to a binary signal.

Figure 5 shows the NE565 (IC1) organized as an FSK decoder of a 1070-Hz to 1270-Hz input waveform. When the signal appears at the input, the loop locks to it and tracks it be-

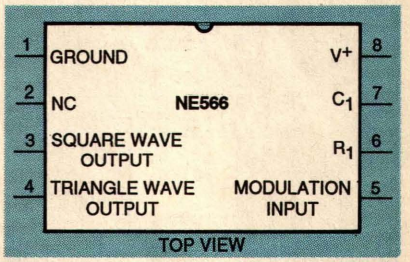


FIG. 8—PINOUT DIAGRAM of the NE566 function generator.

TABLE 2—ELECTRICAL CHARACTERISTICS OF THE NE566

Parameter	Min	Typ	Max	Unit
Supply voltage	±6		±24	V
VCO Characteristics				
Maximum operating frequency		1		MHz
Drift with temperature		300		ppm/°C
Drift with supply voltage		0.2	2.0	%/V
Control terminal input impedance		1		MΩ
FM distortion(±% deviation)		0.4	1.5	%
Maximum sweep rate		1.0		mHz
Sweep range		10:1		
Triangle wave output				
Impedance		50		Ω
Output voltage level	1.9	2.4		Vp-p
Linearity		0.5		%
Square wave input				
Impedance		50		Ω
Voltage	5.0	5.4		Vp-p
Duty cycle	40	50	60	%
Rise time		20		ns
Fall time		50		ns

tween the two frequencies, with a corresponding DC shift at the output.

Loop filter C2 has a small value to eliminate overshoot on the output pulse, and a three-stage RC ladder filter removes carrier components from the output. This filter has a band edge that is approximately half way between the maximum FSK keying rate (300 baud or 150 Hz) and twice the input frequency (about 2200 Hz).

The NE529 (IC2) is a high-speed analog voltage comparator that combines a Schottky diode with two high-speed TTL gates and a precision amplifier on a monolithic chip. It is useful in analog to digital conversion and can act as an interface between TTL and ECL circuitry.

An NE529 between pin 6 of IC1, the NE565, and the output of the circuit makes the output of the filter CMOS logic compatible. Adjusting trimmer potentiometer R3 sets the free-running frequency of the VCO to give a slightly positive output voltage when a 1070-Hz input signal is applied.

The input connection of the circuit shown in Fig. 5 is typical for applications where a DC voltage is present at the source, preventing a direct connection. Both input terminals are returned to ground with identical resistors. In this circuit, the values of resistors R1 and R2 were selected to give a 600-ohm input impedance.

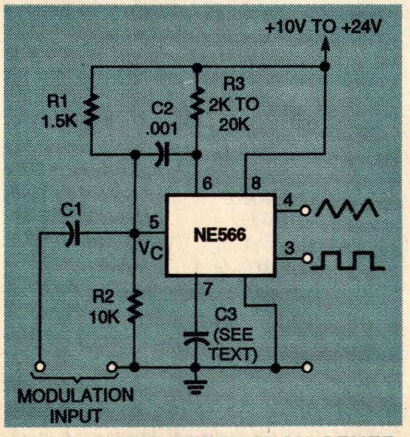


FIG. 9—FIXED FREQUENCY GENERATOR circuit based on the NE566 function generator.

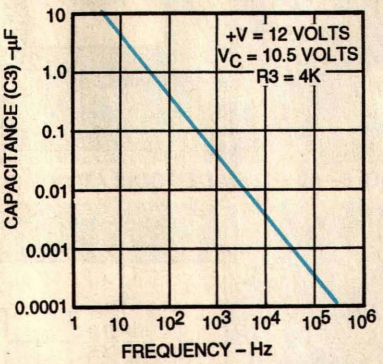


FIG. 10—GRAPH OF FREQUENCY as a function of capacitance for an NE566 when R3 = 4 kilohms.

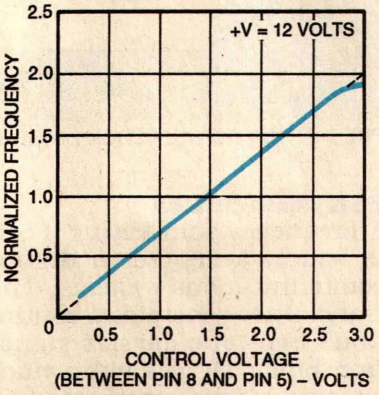


FIG. 11—GRAPH OF NORMALIZED frequency of the Fig. 9 circuit as a function of control voltage.

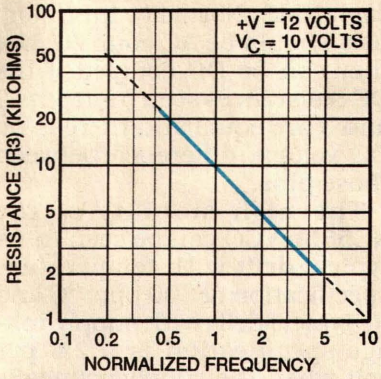


FIG. 12—GRAPH OF NORMALIZED frequency of the Fig. 9 circuit as a function of resistance R3.

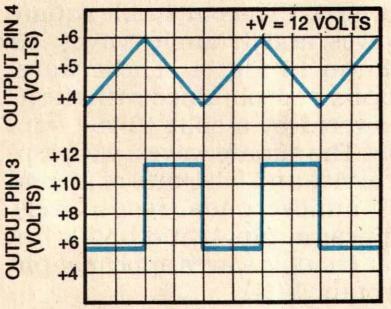


FIG. 13—GRAPH OF VCO OUTPUT waveforms for the generator circuit of Fig. 9.

Single-ended power

Figure 6 shows the NE565 configured as a 60-kHz FM demodulator that is powered from a single-ended 12- to 24-volt supply.

A resistive voltage divider (R1 and R2) and R3 and R4 apply a balanced bias voltage to input pins 2 and 3 of the NE565. The

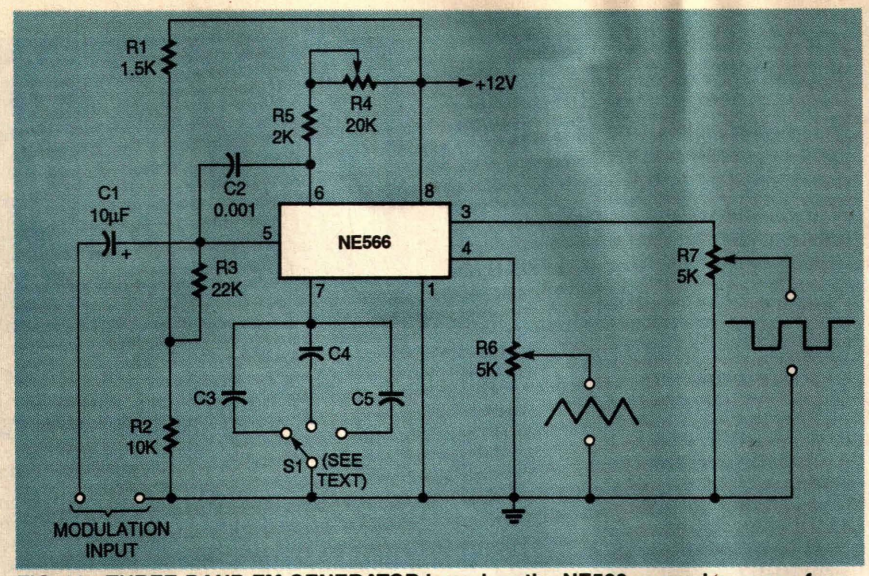


FIG. 14—THREE-BAND FM GENERATOR based on the NE566 general-purpose function generator.

60-kHz FM input signal is AC-coupled to pin 2. The VCO's free-running frequency is set to 60 kHz with R6, C2 and trimmer potentiometer R5. The decoded output signals are fed through a three-stage, low-pass filter to minimize the effects of unwanted noise on the signals.

NE566 fundamentals

The NE566, a general-purpose function generator, is a linear voltage-controlled oscillator capable of producing buffered squarewave and triangle-wave outputs, at fixed and variable frequwncies, up to a maximum of about 1 MHz. Its frequency of oscillation is determined by an external resistor and capacitor and the voltage applied to the control pin.

The oscillator can be programmed over a ten to one frequency range by the appropriate selection of an external resistance. It can also be modulated over a ten to one range by a control voltage. The NE566 finds applications in tone, signal, and clock generators, as well as FM modulators.

Figure 7 is a block diagram of the NE566. The principal blocks are current sources, a Schmitt trigger, and two buffer amplifiers. Two essential external components, R1 and C1, are shown. The VCO section consists of the pair of voltage-controlled current sources that linearly charge or discharge an external timing capacitor.

A linear triangle wave is generated across the capacitor and appears at pin 3, and a square wave generated at the Schmitt trigger switches the current sources when the capacitor voltage reaches preset levels. These waveforms are available at the output pins of the buffer amplifiers.

Figure 8 is the pinout diagram for the popular 8-pin plastic DIP package. The NE566 is, however, also packaged in a 14-pin DIP package. Table 2 lists selected electrical characteristics of the NE566. It can be seen that the impedance values for both the triangle-wave and squarewave outputs are a low 50 ohms.

Figure 9, a schematic showing the NE566 configured as a fixed-frequency FM waveform generator, shows the locations of the external components required for its functioning. Frequency is determined by resistor R3 with capacitor C3 and by the voltage applied to its control terminal.

Resistor R3 must have a value between 2 and 20 kilohms but capacitor C3 can have any value. The control voltage must be between ¾ and the full supply voltage.

The output frequency can varied or modulated over a ten to one range by variation of the control voltage. Capacitor C2, connected between pins 5 and 6, has a value of 0.001µF to stabilize the circuit.

The operating frequency of the NE566 is:

$$f_o = \approx (+V - V_C)/R3 \times C3 \times +V$$

Resistor R3 should be in the range of 2 to 20 kilohms.

Figure 10 is a graph of output frequency as a function of the values of capacitor C3 when R3 has a value of 4 kilohms. The frequency can be varied from 5 Hz with a C3 of 10µF to about 200 kHz with a C3 of 0.0001µF. Figure 11 is a graph of normalized frequency as a function of control voltage, and Fig. 12 is a graph of normalized frequency as a function of resistance R3. Figure 13 is a graph of VCO outputs of the circuit in Fig. 9 when the power supply is 12 volts.

Figure 14 shows a modification that can be made to the Fig. 9 schematic to convert it into a wide-range, three-band FM generator. The frequency can be altered by trimmer potentiometer R4, and three different frequencies can be obtained with selector switch S1 in series with C3, C4, and C5 in parallel and connected to pin 7 of the NE566. As stated earlier about Fig. 9, capacitor C3 can have any value, so C3, C4, and C5 can have values to give three different frequencies.

The voltage levels of the triangle-wave and squarewave outputs can be varied by trimmer potentiometers R6 and R7. Those waveforms can be frequency modulated by applying the modulation waveform to pin 5 through input capacitor C1. Resistor R3 raises the circuit's input impedance to its value of 22 kilohms.

The NE565 PLL and associated NE566 function generator are useful intergrated circuits to be familiar with. The circuits presented here should give you a working knowledge of the ICs' applications.

The final article in this series about PLL devices will describe the NE567, a highly stable phase-locked loop device. Although it is primarily used as a tone decoder, the IC has additional applications as well. Ω

continued from page 62

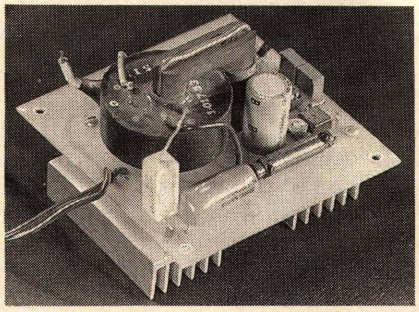
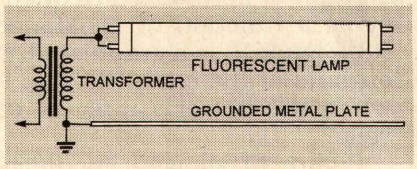


FIG. 3—THE PULSE GENERATOR can be built on a small piece of perforated construction board.



4—SUFFICIENT RF ENERGY is radiated to light small fluorescent lamps up to several inches away, without wires.

Construction and adjustment

Begin construction with the pulse generator. It can be built on a small piece of perforated construction board. After installing all components, verify all connections, and apply 12 volts to the circuit. Verify that a pulse train is present at pin 3 of IC1 with an oscilloscope. While examining the waveform at pin 3, determine that both potentiometers (R2 and R4) function correctly by changing both the on and off time periods.

If that circuit works satisfactorily, turn off the power, insert the components, and wire the remainder of the circuit. Leave the connections to the primary winding of T1 open. Apply power and examine the waveform on the collector of Q1 with an oscilloscope. Verify that the waveform is the same as that present at pin 3 of IC1, but inverted. (There might be slight rounding of the leading edges due to the capacitive effects of Q3.) Temporarily connect a 10-ohm, 10-watt resistor in place of the primary of T1. Verify that Q3 is switching the current on and off in sync with the signal at pin 3 of IC1.

If the circuit appears to be operating correctly, adjust R4 to produce an off time of about 10 microseconds (μs), and adjust R2 for an on time of 60 to 70 μs. Remove power and the temporary 10-ohm resistor. Connect T1 to the circuit and apply power, observing the current that the circuit draws. With all circuitry operating correctly, some corona should be visible on the high-voltage lead of T1, accompanied by a slight hissing noise. (There might also be a faint whistle from T1.)

Attempt to create an arc from the high-voltage lead of T1 with a grounded lead. The voltage should be high enough to strike an arc of over ½ inch inch. By adjusting R4, maximum voltage output can be obtained. Similarly, small adjustments to R2 will also affect output power. Figure 3 is a photograph of the author's prototype.

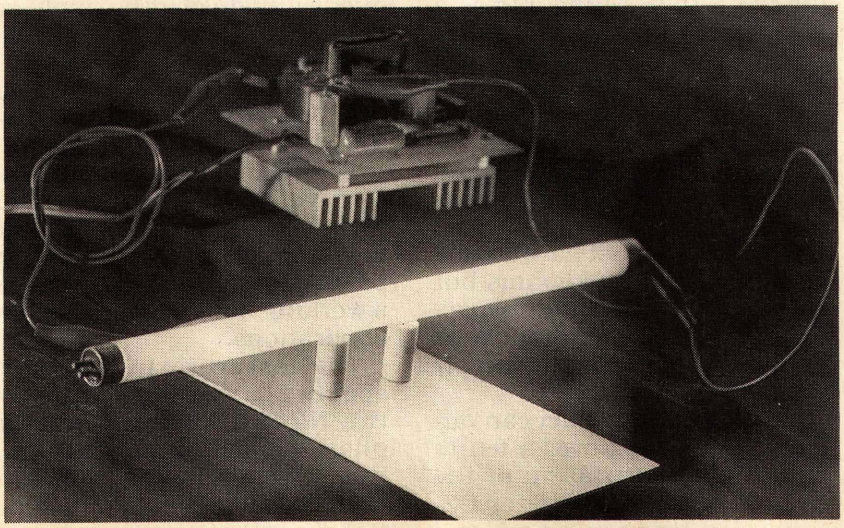


FIG. 5—THE FLUORESCENT LAMP lights above a grounded metal plate.

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Applications

Many interesting experiments can be performed with this circuit. By attaching a small brass drawer knob to the high-voltage lead, sufficient RF energy will be radiated to light low-wattage fluorescent lamps up to several inches away, without wires (see Figs. 4 and 5).

The solid-state Tesla coil has enough power to drive decorative plasma lamps. By adjusting R2 and R4, various discharge patterns can be obtained. A modulating voltage on pin 5 of IC1 will modulate the output and create more interesting visual effects.

The low-current output of the solid-state Telsa coil is not an extreme hazard to healthy adults. However, the high-voltage output should still be treated with respect. The shock can be dangerous to people with heart problems. and [illegible]rc can easily start a fire. Ω

HARDWARE HACKER

More on dowsing, reprints and standards, using helical resonators, a scientific method review, and a new laser service manual.

DON LANCASTER

There sure were a lot of readers who responded to our recent dowsing contest. Several revealed detailed information on new controlled studies, all with highly negative results. Several others genuinely and truly believed in dowsing, but presented their cases on blind faith alone.

Check the *Skeptical Enquirer* issue 4-1 pages 16–20; 6-4 pages 34–37; 8-1 pages 138–140; and 15-3 pages 386–397 for a lot more negative evidence. Or see the *Untapped Technology in Review*, Spring 1994, pages 4–7, for a bizarre sampling of current pro-dowsing thought.

I thank all readers who sent me mountains of information on dowsing—virtually all of it is totally devastating to the dowsing cause. The Skeptical Enquirer will pay $10,000.00 cash to anyone who can use a dowsing rod to detect any buried flowing pipe in a properly controlled test.

There's also a dead wrong popular myth about finding water wells. As a spelunker, I can assure you that rapidly flowing underground rivers are *extremely* rare. A well simply taps into a *permeable* (or porous) layer above an *impermeable* (or solid) layer—something like a straw in a bowl of oatmeal.

Except near the *cone of depression* of an existing and flowing well, the water pretty much just sits there. *The usual flow rate is zero. Any* device (scientific *or* pseudoscientific) that searches for flowing water will be of no use in finding new wells.

Over the years, I've had lots of questions about those long distance electrostatic treasure finders. One industry expert dissected a $2500 unit and discovered less than $6 worth of surplus parts haphazardly arranged in a very simple and highly questionable circuit. Apparently they are nothing but high-tech coat hangers.

The intent is to make a dowsing rod look like an induction balance treasure finder. Their "unconditional guarantee" is simply to ward off the Federal Trade Commission.

Although I am a believer in the *scientific method*, this is *only* a belief system. With *any* belief system, some things are unknown and others stay inherently unknowable. Thus, you can *not* use the scientific method to disprove dowsing. All you can do is show that repeated tests fail, making any dowsing credibility more and more unlikely.

The scientific method

The scientific method is a belief system in which observed effects have underlying physical causes, and the relationship between cause and effect has rational mathematical *and* experimental bases to support it.

Typically, something has happened and you want to know *why*. Or you want to cause something to happen and you want to know *how*. In either case, you'll make an educated guess called a *theory* or a *premise*. You'll then attempt to perform the simplest possible lab experiment or else work out the simplest possible mathematical

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FIG. 1—HEWLETT-PACKARD MANUALS are helpful in repairing most popular laser printers from dozens of manufacturers. Here's the latest update.

analysis that will test your theory for accuracy. This is known as a *model*. The purpose of your model is to get the intended effect to show up consistently.

Then you tell others about your results, and invite them to duplicate them. Should enough independent outsiders duplicate the results repeatedly, the theory is upgraded to "law" status. A law is just some theory that nobody has been able to disprove.

For the scientific method to work, there has to be a *balance* between lab experiments and math theory. Too much of either will *always* be suspect. Underlying *hidden variables* or *alternate causes* must be eliminated. All of the observed effects also must obey the statistical laws. Just because something happens once is not proof. It has to be repeated many times until the results are beyond a shadow of a doubt.

One of the things that pops up over and over again when using the scientific method is that many effects obey a *square law*—that is, they drop off rapidly with respect to distance. In most radar detection or treasure-finding situations, both the illuminator and the target emissions drop off in accordance with a square law. The sensitivity of these systems drops off as the *fourth power* of distance.

Another unavoidable aspect of the scientific method is the *noise floor*. There is a certain limit below which events are unobservable. It is caused by inherent sources of interfering signals that are stronger than those one is trying to measure. One example is the thermal emission noise inherent in anything that's not at a temperature of absolute zero.

Certain techniques can be performed to reach well down into noise, such as filtering, integration, or correlation. But the noise floor will *always* set an ultimate limit.

Enter Heisenberg and Company

The bane of the scientific method is an even more fundamental "gotcha" known as the *Heisenberg Uncertainty Principle*. This principle states that *you cannot measure something without disturbing it*. At the lowest level, if you try to extract information from a system, you alter its condition.

Let's look at two wildly different examples. Say you want to verify Ohm's law by measuring the current through a 2.2K resistor. It seems simple enough—just apply a one-volt source and then look for a value like a 455-microampere current. But even with this "pure physics," you can easily get into lots of trouble. Why? Any current-measuring device has a voltage drop across it, and any voltmeter draws current. They cause inherent instrumentation errors.

Dissimilar contacts generate thermocouple voltages. The resistor might be photosensitive. Power line hum or the local radio signals might be getting into the measurement. You might have forgotten to calibrate or ground your oscilloscope probe. Or other energy sources might cause transient currents. Even your test current can cause a *self-heating* effect that shifts values. Somebody might have painted the wrong stripes on the resistor, or you might be color blind.

Thinking "positive psychic thoughts" about your resistor is unlikely to change the results. But trying to please your boss just might—as might trying to get through your school lab report or daydreaming about a giant clockwork armadillo instead. But all this is largely manageable, one way or another.

Suppose, instead, that you want to prove that *L-Carnitine* is a cheap and safe cure for heart disease. Now the uncertainties and the hidden variables get ugly in a big hurry.

Most psychic effects tend to be highly controversial. But one psychic phenomenon that has strong proof of its validity is the *placebo effect*. It has been observed time and time again that a patient who wants to get well and who feels that he or she is taking positive steps toward that goal is significantly more likely to do so. But just watching someone taking L-Carnitine won't work. Chances are the patients are taking other stuff too, or they are doing other things that'll make their problem better or worse.

So, for the scientific method to work here, you have to do *double blind testing* of thousands of patients in which neither the patient nor the doctor knows whether the real medicine or a placebo is being used. Actual selection has to be done on a totally random basis by a third party. Otherwise, unavoidable visual clues and other hidden variables will trash the test results.

Similarly, the only credible way to raise or lower the apparent validity of dowsing or any other psychic effect is by large-scale double-blind testing. All of the dowsing tests I know about seemed to have failed.

Once again, it is not fair to discredit anything you know nothing about. But from all of my research to date and from what you've told me, dowsing appears to be an outright scam. The "dowsing reaction" appears to be something the dowser wants to see happen, or else it is a chaotic effect.

A correction or two

Whoops. I apparently said some things that were just plain wrong two issues ago in my transmission line story. Here are the correct statements. A *shorted* transmis-

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sion line will appear as a short circuit at zero length, as an open at *one quarter* wavelength, and back to a short at *one half* of a wavelength, neglecting losses. The line will appear to be inductive at *less* than one-quarter wavelength and capacitive at *more* than one-quarter—but less than one-half—wavelength.

Note that a round trip on a quarter wavelength stub is actually one half of a wavelength long, and that any short circuit inverts reflections.

An *open* transmission line appears as an open at zero length, as a short circuit at *one quarter* wavelength, and back to open again at *one half* of a wavelength. The line should appear capacitive at *less* than one-quarter wavelength and inductive at *more* than one-quarter wavelength. These changes have been picked up in HACK79.PS on *GEnie* PSRT.

New laser training manual

Don Thompson has just released his new volume on *Mastering Laser Printer Service*. It contains detailed step-by-step technical information on repairing all of the *Canon* series "engines" used in the most popular printers from *Apple*, *Hewlett-Packard*, *QMS*, and others.

You'll find hundreds of pages of proprietary "from the trenches" information in Thompson's book that's not available elsewhere. It includes such insider secrets as the zero cost cure for those flaky connectors on the SX engine, rapid repair shortcuts, and much more. There is also information on running your own repair service.

I particularly like the dozens of printouts of the actual page problems and his unique pie-chart method of breaking down probable causes. All of it is based on thousands of real-world case histories.

As a small sample of its contents, Fig. 1 shows a listing of the little known Hewlett-Packard manuals that are handy for repairing most laser printers from any source. Any and all of these can be ordered from *Hewlett-Packard Manuals*.

Don Thompson's book is not cheap, but his company has set up a special offer for *Hardware Hacker* readers. Contact him directly for further details.

Helical resonators

Above 100 megahertz, conventional coils and capacitors create design problems. Stray capacitance and inductance often dominate, and unwanted coupling occurs. The Q values tend to drop off and stability degrades.

The usual solution is to go to some *distributed* network in which the inductance and capacitance is "spread out" rather then being concentrated in distinct lumps. If the network can be self-shielding, so much the better.

A *cavity* is the stock solution at microwave frequencies. A cavity is simply any *conductive enclosure*. A cavity can resonate at many possible frequencies. Field equations explain cavities in any situtation in which an E-field is *across* a conductor or an H-field is directed *into* it, a conductor will resonate.

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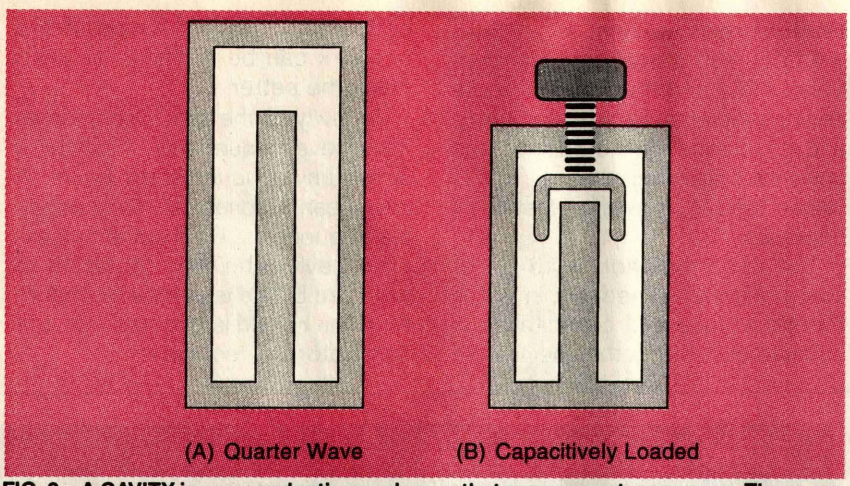

FIG. 2—A CAVITY is any conductive enclosure that can support resonance. These are common at microwave frequencies. Energy can be coupled in or out with magnetic loops, electric probes, or electron beams. Here are cross sections of two examples of simple coaxial cavities.

Normally, you use the simplest and most obvious solutions to the field equations. These are called *low order resonance modes*.

Figure 2-*a* shows a *coaxial* cavity. It is a sealed cylinder that has coaxial rod inside it. If the rod is precisely a quarter wavelength long, it can support resonant energy, with resonant current at a maximum at the shorted bottom and resonant voltage at a maximum at the open top.

The resonant frequency depends on the length of the rod. The Q is determined by surface conductivity and the diameter ratios. In general, the larger the cavity and the better its surface conductivity, the higher its Q. One-piece cavities machined from solid blocks are usually better than built-up ones.

In Fig. 2-*b*, the cavity is *capacitively loaded*. That results in a more compact size and a tuning option. Sometimes a plain old machine screw or two is all you need for tuning. Other times, a variable capacitor or varactor diode will be used.

Energy can be coupled into or out of a cavity in several ways. A wire loop can be used for *magnetic* or "H-field" coupling, or a wire probe can be used for *electric* or "E-field" coupling. Simply leaving a hole in the side of the cavity will also let energy in or out. Carried to an extreme, a very long cavity intended to move energy is called a *waveguide*.

The position of the probe or the size of the hole defines the ratio of unloaded versus loaded Q and thus the bandwidth of the resonator. The low-frequency equivalent would be a tap on a coil.

Cavities are temperature- and humidity-sensitive. Temperature can be compensated by the choice of the cavity base metal, and the addition of a small bellows, or by purposely adding components whose temperature drifts are in the opposite direction. Active automatic frequency control feedback is another temperature compensation solution. The best base material is *Invar*, which has a near-zero temperature coefficient. One way to avoid humidity problems is to hermetically seal the cavity in a vacuum or dry nitrogen.

The Q of a cavity is very sensitive

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to the conductivity of its walls. While hardware hackers might get by with soldered printed circuit boards, the highest Q cavities should be gold- or silver-plated. Q values of several thousand are easily met.

Microwave oven magnetron RF oscillators have a cavity, as do many radar speed detectors. In fact, just about all microwave applications include one or more cavities. But for VHF and UHF frequency operation, cavities are big and expensive.

Enter the *helical resonator*, stage left. It's a cross between cavities and discrete L-C circuits. It is a cheap and effective device for everything from improved FM reception to ham television and wireless cellular phones.

Figure 3 shows a helical resonator. All you do is take an ordinary coaxial cavity and twist its center

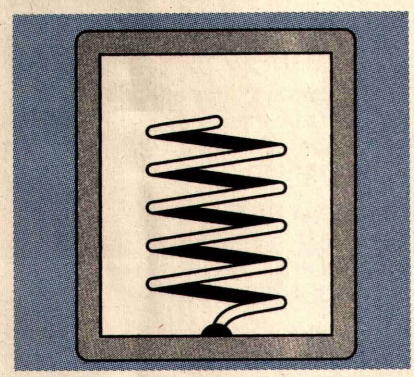

FIG. 3—THE HELICAL RESONATOR is a cavity variation that is more suitable for VHF and UHF. They can be easily made from wire and printed circuit board stock.

conductor, making a helix out of it. The final size is a lot smaller this way, and tuning can still be done with a variable capacitor.

You do *not* just have a plain old series inductive capacitive circuit here. Most of the resonating capacitance is obtained from coil to wall spacing in a distributed and time-sensitive transmission network.

Figure 4 shows a two-stage helical filter. Energy is coupled into the first stage from a suitable tap, something like an impedance step-up transformer. A "hole in the wall" can provide interstage coupling, and energy is finally tapped out of the second stage. The size and the other details vary according to what you want the filter to accomplish.

You could easily make your own helical resonators from soldered printed circuit boards and heavy wire. Avoid any supports on the "hot" end of the helix as they will dramatically lower the Q. Fancy math might be needed for the design, and some experimentation.

More information on cavities in general appears in *Reference Data for Radio Engineers*, the *Radio Engineer's Handbook*, and in most microwave texts. One source for surplus cavities is *Fair Radio*.

The "horses mouth" paper on the helical resonators showed up in the December 1959 *Proceedings of the IRE*. Reasonably priced helical filters are manufactured by *Toko* and stocked by *Digi-Key*.

Please let me know if you find any newer and readable papers on helical filter and resonator designs. A free *Incredible Secret Money Machine II* for your trouble.

Resource resources

I just got a new UMI (formerly *University Microfilms*) catalog, so I decided it is high time to gather the most significant of my fundamental research tools into one sidebar. UMI is *the* place to go for hard copies of almost any magazine story or journal paper. Sadly, the free *Interlibrary Loan* services of many libraries are being discontinued, and others seem to be slower and unreliable. UMI is now associated with *The Information Store*, and it sells all the "hard to get" information such as standards or conference records.

Major standards associations were listed in *Hardware Hacker II* and in HACK47.PS on *GEnie* PSRT. Another place to pick up standards is *Global Engineering Documents*.

I have mentioned the *Ulrich's Periodicals Dictionary* before as the single most important Hacker resource ever. Its competition is the *International Standard Periodicals Dictionary*.

Other library resources include the *Encyclopedia of Associations*,

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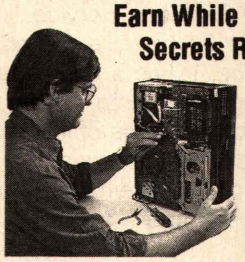

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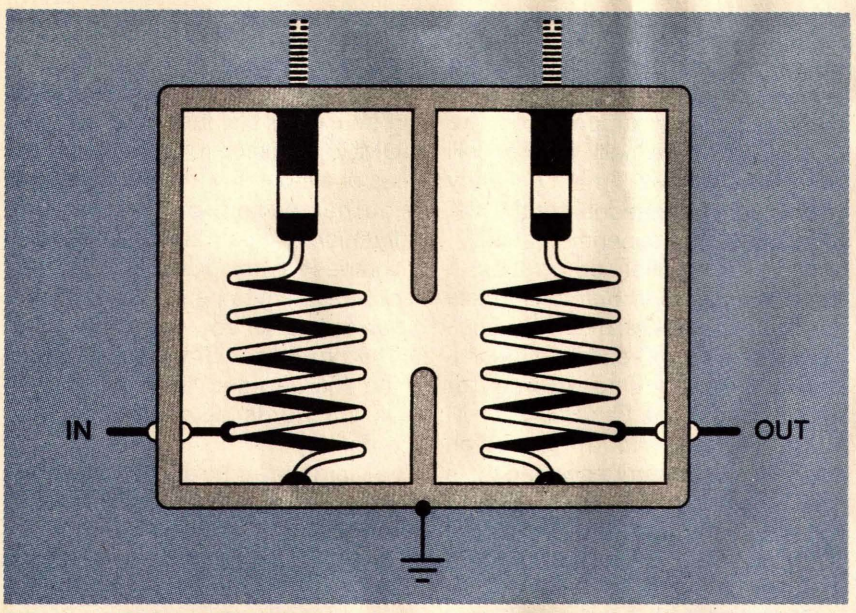

FIG. 4—A TWO-STAGE FILTER made from helical resonators. Energy is coupled between resonators by the hole in the wall. The input and output taps serve as impedance step-up and step-down transformers.

the *Thomas Registry of Manufacturers*, *Books in Print*, and the *Science Citation Index*. That index lets you move *forward* through time, finding newer and newer material as you go.

The major publishers of reference directories are *Gale*, *Oxbridge*, and *Bowker*. Check any library.

My favorite online resource to find out *anything* from *anywhere* is the *Dialog Information Service*. It is now available 24 hours a day as a *GEnie* service. It has a surcharge-free Dialog practice area. Dialog is the broker for hundreds of information sources. Three sources of major interest to hardware hackers are INSPEC, MATHSCI, and COMPENDEX.

And then there is the Internet—all zillion terabytes of it. Chances are you can instantly talk to an expert, once you figure out *which* of those zillion terabytes to access. Lots of very informative Internet guides are now available.

Of the alternative resources, my two favorites are *Rex Research* for pseudoscience stuff, and *Factsheet Five* for little-known reviews. The *KeelyNet BBS* is another weird and wondrous pseudoscience resource. If you have any research favorites of your own that I haven't mentioned, please be sure to let me know about them, so that I can let others know about them.

New tech lit

Philips has a fat and free new *80C51 Application Notes* manual. *Samsung* has free samples of its new *microMOSFETs*. These are very small high-current switches.

New lasers that literally could be *painted* onto almost any substrate are detailed in the *Photonics Spectra* for August 1994, pages 119–124. A good bibliography is included in it.

Computer Video is a brand new trade journal from the *Radio News* folks. It's free, and has a surprisingly good mix of technical information. Two leading sources for most video products are *B&H* and *Markertek Video Supply*.

Loose Change is a magazine for slot-machine restorers and rebuilders from the *Mead Publishing Company*. It also has lots of *Pictorial*

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Guide repair manuals for popular vintage slot machines. Most states now allow private ownership of classic slot machines as antique collectibles. But check first.

Stupendously major breakthrough! I finally found out where to go for *real* steam calliopes! Check out the *Rough and Tumble Engineers Historical Association* in Kinzers, PA. They have year-round events. Meanwhile, modern replica air calliopes remain available from *Ragtime*.

The *Neon News* is a newsletter for the neon sign trade. Many thanks to Steve Hansen for this information. As I've said before, Steve publishes the *Bell Jar*, a superb labor-of-love newsletter on homebrew high vacuum.

For the insider secrets on forming your own technical venture, check into my *Incredible Secret Money Machine II*. It's also available as part of my *Lancaster Classics Library*.

A reminder that electronic reprints of all my columns, along with instant technical help, are now offered on *GEnie* PSRT. I've managed to arrange ten free *GEnie* hours for your use as indicated in the help box. Free catalog requests and technical questions you want answered here or on PSRT can also be sent to me via E-mail at my SYNERGETICS@GENIE.GEIS.COM Internet address.

As usual, most of the resources I've mentioned appear in the *Names & Numbers* or the *Resource Resources* sidebar. Be sure to check those two sidebars first before you decide to call our no-charge technical helpline. Ω

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XFS-CASE KIT $13.95
XFS108 (C) KIT $41.95

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XPS-CASE KIT $13.95
XPS1000 (C) KIT $49.95

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- Adjustable from 88 to 108 MHz.
- Up to 1 mile range.
- Works with any FM broadcast receiver.

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- Adjustable from 88 to 108 MHz.
- Up to 1 mile range.

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- Powerful 2 stage audio amplifier.

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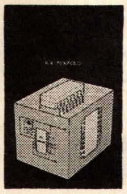
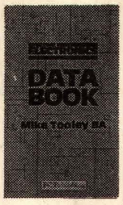
☐ **BP321—Circuit Source-Book 1... $6.50.** A collection of over 150 analog-signal circuits on audio signal and power amplifiers, DC amplifiers, signal filters (high-pass, low-pass, band-pass and notch), tone controls, voltage-controlled amplifiers and filters, triggers and voltage comparators, gates and electronic switching, bar graphs, mixers, phase shifters, sensors, digital circuits, etc. (See BP322 at right)



☐ **BP322—Circuit Source-Book 2... $6.50.** Contains over 170 circuits on signal generation, power supplies and digital electronics. A continuation of BP321. Topics are: 555 oscillators, sinewave and function generators, CMOS oscillators, voltage-controlled and RF oscillators, (555, TTL and CMOS) monostables, precision long timers, power supply and regulator circuits and many other useful circuits. (See BP321 at left.)

☐ **PCP108—Computers and Music...$9.95.** The text leads you through the topics on computers and music software. Learn how to choose the right components for a system to suit your personal needs and fully equip yourself to exploit that system.



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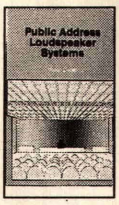

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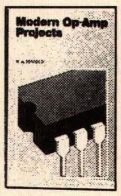
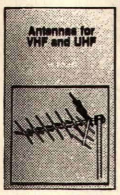


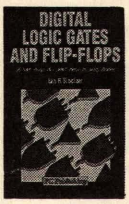
☐ **BP106—Modern OpAmp Projects... $5.75.** Various projects that make use of operational amplifiers available to hobbyists. Text includes low-noise, low-distortion, ultra-high input impedance, low slew-rate and high current types.

☐ **BP245—Digital Audio Projects...$5.95.** Practical details of how to construct a number of practical projects. All should be of interest to most audio and electronic music enthusiasts. Some of the projects are: oscilloscope storage circuit, A/D converter, negative supply, input amplifier, low-noise microphone preamp, compressor and expander circuits, input mixer, echo effect circuit, and others.



☐ **BP301—Antennas for VHF and UHF...$6.00.** From installing a TV or FM antenna to setting up a multi-antenna array for shortwave listening or amateur radio, this book explains the essential basics of antenna operation and installation. The text describes in easy-to-understand terms the necessary information about how antennas work, the advantages of different types, and how to get the best performance.

☐ **PCP105—Make Money from Home Recording...$10.00.** Start earning money after you spent a "fortune" on all that professional recording gear, MIDI and all. Here's the book that tells you how! Whether you have a fully fledged recording studio at home, or just a couple of stereo cassette recorders and a microphone, you'll be able to put the ideas presented in this book into immediate practice and make money.



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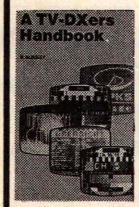

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WHAT'S NEWS

continued from page 4

more efficient use of silicon than in conventional programmable logic device (PLD) fabrication and promises higher gate counts per unit area.

The more efficient use of silicon is expected to permit Xilinx to sell FPGAs at half the price of comparable conventional PLDs because less silicon is used. Alternatively, the new process will permit more than twice the number of gates to be placed on a die than is possible with existing SRAM- and EPROM-based fabrication methods.

The Xilinx MicroVia antifuse layer of amorphous silicon sandwiched between two metal conductive layers can be added to the standard CMOS logic wafer with only a few additional processing steps. An antifuse forms a permanent conductive connection to organize the gates for a specific application in contrast to a *fuse* in programmable PROMs which is opened or "burned" to break existing connections between gates to achieve the same circuit.

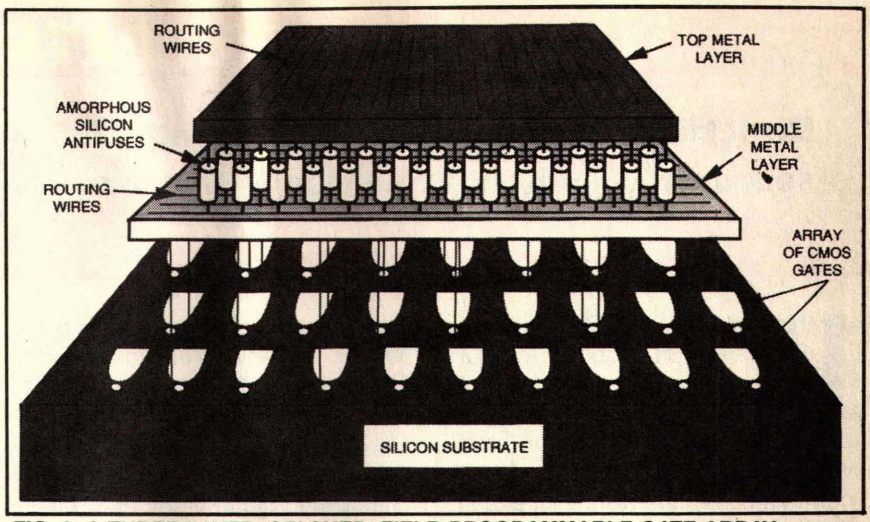
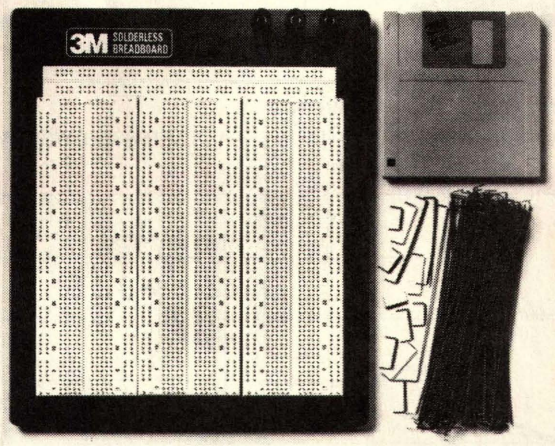


FIG. 2. A THREE-LAYER, STACKED, FIELD-PROGRAMMABLE GATE ARRAY economizes on silicon. Current programmed to flow through the amorphous silicon antifuse layer forms permanent connections that dedicate the array of CMOS gates for a specific application.

Xilinx reports that it has made test memories and other structures with its MicroVia metal-to-metal antifuse structure, three-layer-metal CMOS process, and sea-of-gates technologies. For example, a 6000-gate FPGA based on the new technology has been undergoing evaluation

Continued on page 92

3M breadboards for less dough.



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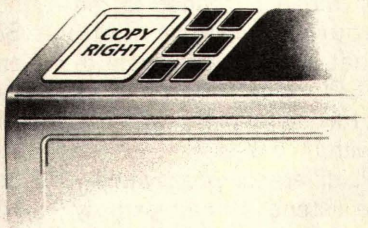

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AUDIO UPDATE

Directional hearing: New data indicate that sensing the source of a sound isn't a psychoacoustically simple exercise

LARRY KLEIN

I think we can credit Darwin's natural-selection process for our sense of aural directionality. The ability of our remote ancestors to detect the precise direction from which a saber-toothed tiger was coming (as a guide to the direction they should be going) contributed significantly to our species' survival. The ability to localize sound contributed to the survival of many other species as well.

Human sound localization has been under study since about the middle of the 19th century. Ultimately, it became clear that we use the differences between the sounds reaching our two ears to derive our perception of directionality. English physicist Lord Rayleigh (1842–1919) was the first to determine that a sound coming from the far right or left is significantly more intense in the ear closest to the sound source. ("Significant" means that the sound pressure level, or SPL, difference provides sufficient raw material for the brain to work with.)

The SPL difference is easy to explain: The listener's head partially deflects and/or blocks the impinging sound wave from reaching the far ear. This holds true mostly for the high-frequency sounds. As the frequencies of the oncoming sound waves become lower, and their wavelengths become longer, the shadowing effect of the head diminishes.

At very low frequencies the wavelengths are long enough so that head blockage is no longer a factor, and the intensity differences disappear. For the higher frequencies, however, the intensity difference—Rayleigh called it the "binaural ratio"—continues to provide a basic clue for localization. For this and other work in the physics of sound, Rayleigh won a 1904 Nobel Prize.

Time vs. intensity

Rayleigh subsequently determined that aural localization does not depend on intensity alone. Sounds whose source is "off-axis" are not only stronger at the closer ear, but also arrive earlier. The significance of sonic-arrival time was investigated in another series of ingenious experiments using precisely calibrated tuning forks—a favorite laboratory instrument of the early psychophysicists. Rayleigh concluded that interaural phase differences—or arrival-time differences—also contribute significantly to localization.

It wasn't until the 1930s that things finally got fully sorted out. Present understanding is that localization is achieved by differences in both time of arrival and sound pressure. (There is some evidence that interaural frequency-response differences caused by head diffraction and external-ear shape assist the localization process, but the present view is that the contribution is small, no matter how large the head or misshapen the ears.)

The ear/brain's arrival-time sensitivity begins to roll off at about 1,200 Hz. However, SPL localization doesn't appear to be fully operable until 4 kHz or so, which leaves an ambiguity gap centered at about 3 kHz. This should not be cause for concern, however, because predatory muggers (and performing musicians) can be localized by the wide sonic spectrum they generate.

Two cues

There's a good reason why your

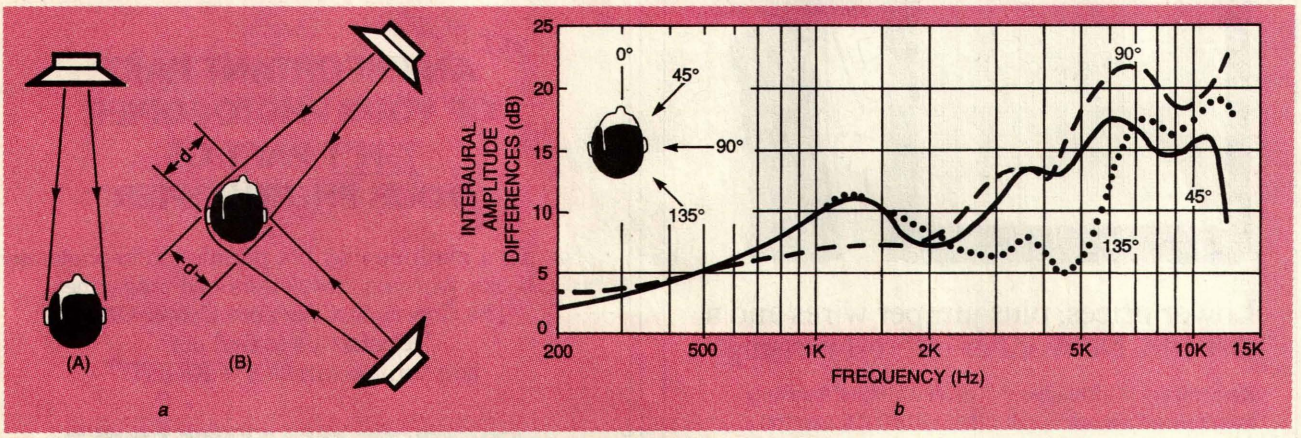

FIG. 1. THE IDENTICAL PATH LENGTHS TO THE EARS are shown at left (a). This localizes the sound source as either directly in front of or directly behind the listener. The brain uses interaural differences (d) shown at (b) to localize off-axis sound sources. At right, interaural differences in signal strength are charted for three off-axis sound sources over the range 200 to 12,000 Hz.

ear/brain mechanism uses (actually, needs) at least two different cuing mechanisms for localization. In general, differences in arrival times are used to localize the lower frequency sound sources, and differences in level are used to localize the higher frequencies. For wavelengths of high- to mid-frequencies, where your head is an acoustic barrier, the difference between the ears is something like 30 dB at 10 kHz, 16 dB at 5 kHz, falling to about 7 dB at 1 kHz.

When the frequency is low enough (i.e., the wavelengths are long enough), the head no longer runs interference and essentially the same signal level is heard by both ears. However, you still sense the arrival time differences, or phase, between the signals reaching your two ears—which is about 0.6 millisecond from a source that is located fully on one side of the head or the other. This information provides the data that is needed for localization.

Below 200 Hz or so, when the wavelengths get very long, arrival-time differences also begin to disappear and directionality begins to disappear as well. That, by the way, explains why the sound from subwoofers is nondirectional.

We generaly understand what happens to sound-pressure waves as they travel through the ear. However, once the "sound" signals reach the cochlea, the spiral-shaped organ lined with hair cells, things get really complicated. Those hair cells are complex mechanical-electrical transducers that convert sound vibrations into microvolt-level electrical signals. Those signals are sent to the mid-brain via the axons in the eighth cranial nerve. (I previously discussed the signal-generating hair cells—and their susceptibility to noise damage—in the December 1992 column.) This description of the hearing-localization process is accepted by psychoacousticians, albeit with certain cavils and reservations.

Aural potentials

Historically, research into the hearing process has always consisted of providing auditory stimuli and then asking subjects what they did or didn't hear. (Hearing aids, for example, are fitted by that process.) But things are changing rapidly. Today's psychoacoustic researchers have a new and sophisticated group of investigative tools. The ability to tap into the microvolt potentials in the inner ear and brain has opened up vast new areas of investigation and discovery.

Dr. John C. Middlebrooks from the University of Florida's Brain Institute recently published his new findings in *Science* magazine. He showed that the auditory system has evolved "coding strategies" that work differently from our other sensory systems. Moreover, the auditory cortex of the brain, where sounds are interpreted, contains a population of cells unlike any others in our nervous system. The special cells in the cortex working on the auditory information processed and forwarded by our right and left inner ears can differentiate and respond specifically to sounds arriving anywhere in the 360° of space around the body!

By placing electrodes in the brains of anesthetized cats, Dr. Middlebrooks found cells that fire differently when sounds arrive from different directions. If a sound comes from a given distance, say 10 feet to the left, the cell will fire in one pattern. As Dr. Middlebrooks put it, "It might go dit, dit, ditty, dit." Sounds originating from a different direction might produce a "ditty, ditty, dit" response. In effect, the research indicates that single neurons can encode sounds from every direction. None of the other brain cells that respond to sensory input from the external world operate in precisely that way.

Does Dr. Middlebrooks' work represent a breakthrough in our understanding of the sound localization process? Perhaps, but I suspect that it simply adds another (if somewhat surprising) bit of data to our still limited understanding of the complexities of aural perception. In any case, we can thank Mother Nature that the stereo hearing facility of our simian ancestors contributed to their survival in a world of long-toothed predators—even if they didn't know how it worked. Ω

VIDEO NEWS

continued from page 6

gramming is in letterbox proportions. Europe's proposed analog HDTV system has already flopped—broadcasters opposed it and governments refused to subsidize it. Although there is much talk about developing a digital HDTV system there, it's noteworthy that a new battleground is developing over widescreen broadcast technology—not high definition. As reported in this column, broadcasting in PALPlus has already started and PALPlus receivers are on sale. The PALPlus system restores letterboxed transmissions to full definition (but not high definition) when received on specially equipped sets.

However, the BBC has now adopted a program to develop digital widescreen broadcasting, with tests due next year and regular service to begin in 1997. The BBC system isn't expected to be high-definition—just widescreen. Meanwhile, a British commercial network has been granted a contract by the European Commission and a TV set manufacturer to broadcast at least 500 hours of widescreen PALPlus by the end of 1995. The arguments on PALPlus vs. digital widescreen are increasing in the U.K. In favor of PALPlus is the fact that the broadcasts are compatible with existing television—conventional sets display the picture with a black band above and below—as opposed to the BBC's planned digital broadcasts. The BBC says, in rebuttal, "We do not wish to impose letterbox viewing on unwilling viewers, as is necessary with PALPlus." Ω

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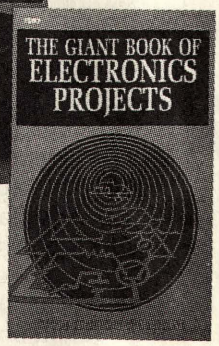

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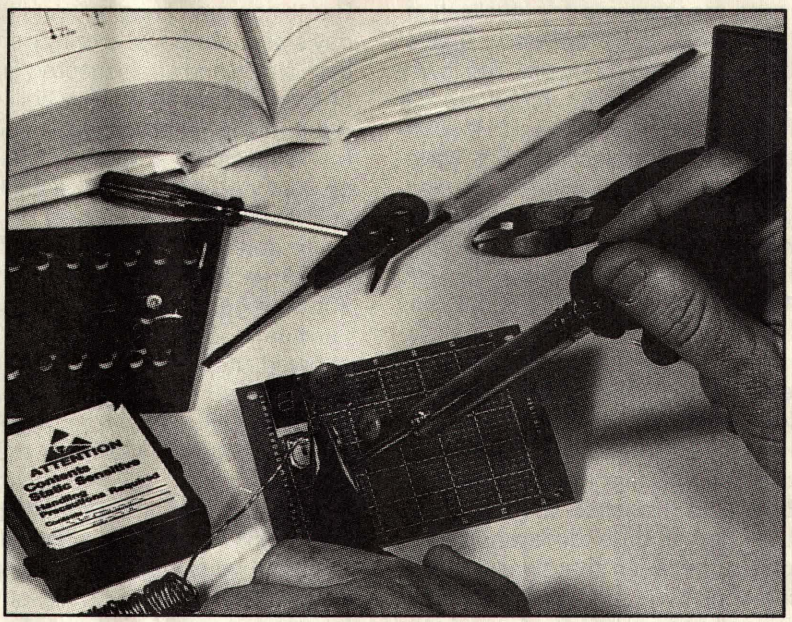

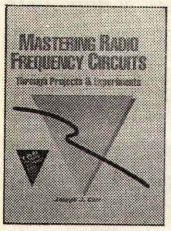

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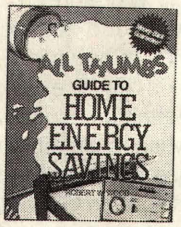

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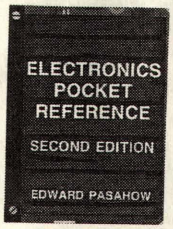

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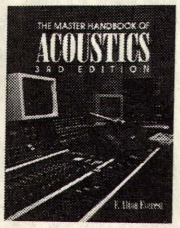

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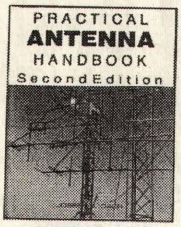

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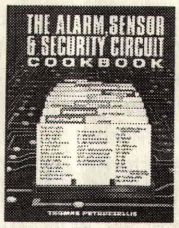

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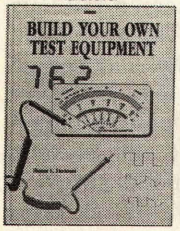

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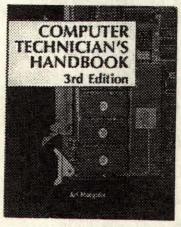

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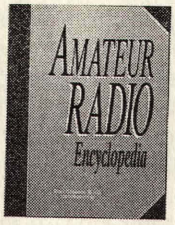

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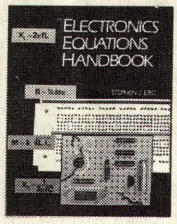

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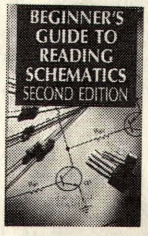

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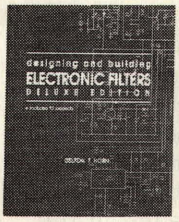

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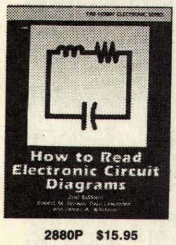

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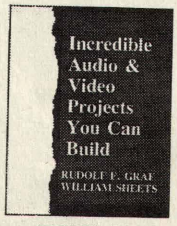

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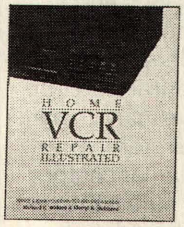

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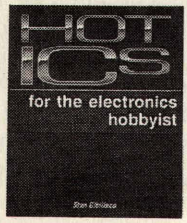

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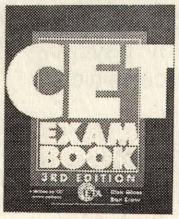

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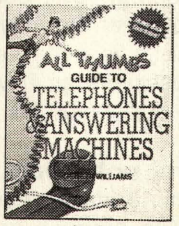

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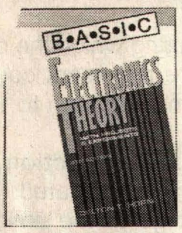

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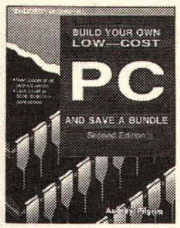

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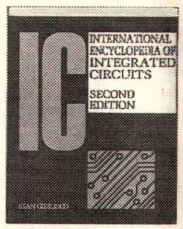

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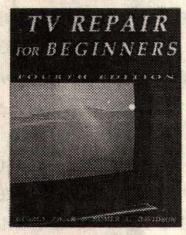

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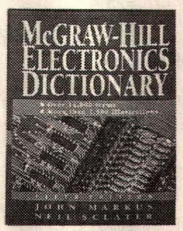

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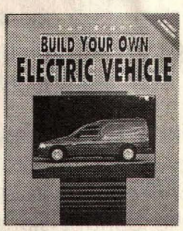

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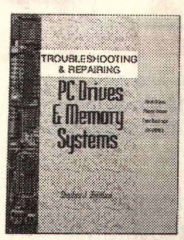

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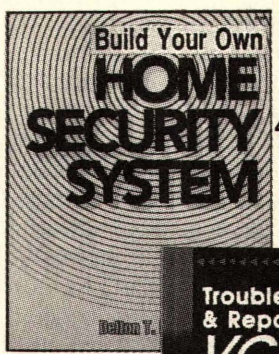

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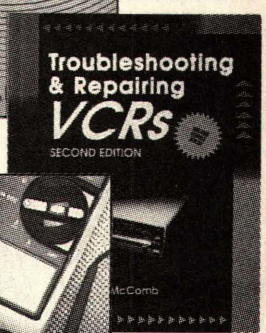

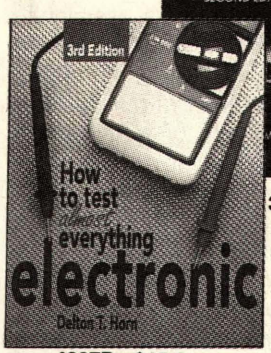

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DRAWING BOARD

Completing the tachometer's spark-counter section.

ROBERT GROSSBLATT

You always have to make compromises between theoretical circuit performance and practical circuit construction. That's what happened last month when I was working out the details of the spark counters. While more bits mean more accuracy, they also mean greater circuit complexity. However, the tachometer's accuracy and stability is a function not only of the number of bits, but also the size of the sample. The larger the sampling period, the less significant will be the loss of the bottom three bits. After all, starting the spark count after eight pulses have passed isn't much of a problem if the counter is going to count at least ten times that number.

The best solution is to enlarge the statistical universe by adding more pulse counters—that's the solution I chose last month. If you absolutely refuse to make any compromises in the range of the tachometer, you'll need more pulse counters, but you'll also get greater accuracy and greater range. You can make these decisions yourself when I finish the design.

The complexity of the design has been dropped to a manageable level by cutting the bit width of the counters. Unfortunately, since the total width of the expected maximum counts is still eleven bits, a convenient synchronous dual binary up-counter like the 4520B can't be used. Although the 4520 is an eight-bit counter and we're only using eight bits, the 4520 doesn't have the eight bits we need. We have to use bits 2 through 10. Without a lot of extra devices, the 4520 can provide only bits 0 through 7.

The circuit will use a long-chain ripple-carry binary counter to add up the spark pulses. That's better than using one in the timing section. In the case of the spark counters, no critical timing operations are performed—all we want to know is how many events have happened in a particular period of time.

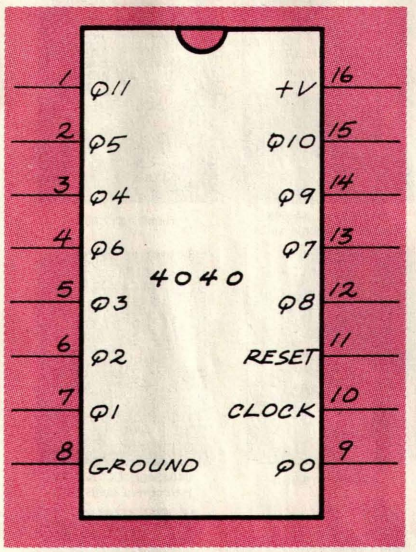

FIG. 1—4040 PINOUTS. The only control pins the chip has are the clock input (pin 10) and an active-high reset (pin 11).

There are several long-chain ripple counters available, but the best one here is the 4040B because it gives a continuous count from bit 0 through bit 11 (a total possible count of 4096). The pinouts for the 4040 are shown in Fig. 1, and you can see that the compromise for a long counter in a small package is a scarcity of control pins. Only a standard clock input (pin 10) and an active-high reset (pin 11) are available.

Getting back to the original problem presented last month of how the counter outputs could be three-stated, a simple octal buffer like the Philips 40240B would do the job, but a better choice would be the 4508B dual four-bit latch. It has three-state outputs and can also store the spark counter output state. This is convenient because it means stable data will be available for the rest of the circuit for a half-second period during which the device can translate the spark count into rpm and then send it on to the display.

The spark counter section is shown in Fig. 2. I've indicated the connections that go to the timing, arithmetic, and display sections. The 4508 is a good choice because both the STORE ($\overline{S1}$ and $\overline{S2}$) and ENABLE ($\overline{E1}$ and $\overline{E2}$) control lines are active-low. When STORE is low, the 4508 will latch the state of its inputs and ignore any further changes. A low on the ENABLE line will make the stored latch data available at the IC's output pins. This means that a common signal can latch the spark counter output and put it on the bus going to the rest of the circuit for further processing.

The next block is for sequence control. This section of the circuit decides which spark counter is read next. It issues the control signals needed to grab that counter's output, get it into the latch, enable the latch outputs, and also reset that spark counter to zero so it can start a fresh count and be ready for the next time it is accessed.

The main "muscle" in the sequence control section is the 4017B. Because the tachometer is designed to update every half a second, the spark counters have to be sequenced and sampled at that rate. The 4017, therefore, has to be clocked at an update rate of half a second, or 2 hertz. The schematic for this section of the tachometer is shown in Fig. 3.

Just about the only drawback here is that active-low signals are needed to control the spark counters, but the 4017 outputs are active-high. The problem is solved by adding some inverters to the outputs. Every half second, the 4017 will select the next spark counter in sequence and cause its count to be

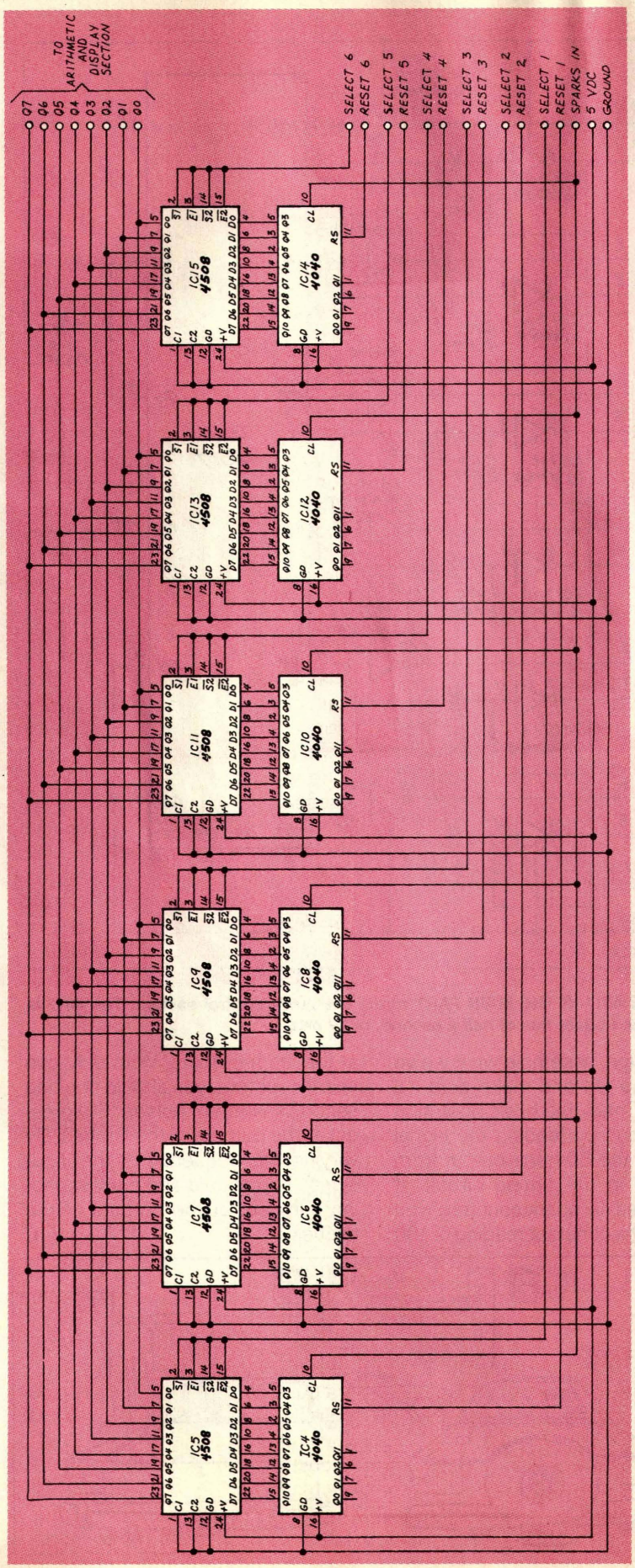

FIG. 2—SPARK COUNTER SECTION. The connections that go to the timing, arithmetic, and display sections are shown.

latched to determine engine rpm.

The seventh output of the 4017 controls the chip's reset pin. After the sixth spark counter is selected, the 4017 will reset, select the first spark counter again, and the sequence will start all over. The capacitor between the reset pin and the positive rail of the power supply gives a power-on reset pulse and makes sure that the 4017 starts its count with the first output.

The 4017 can handle a maximum of ten spark counters, but if you want more than that, you can increase the range by adding another 4017. However, note that the 4017 does not have an output enable control, so there's no easy way to turn off the outputs. The 4017 will always have one high output, and it is difficult to come up with a design that will let two or more 4017s sequence logically across their outputs.

The last subject to cover is the half monostables on the outputs of the inverters that control the spark counter latches. To explain this, I have to go back to the spark counters. Whenever a spark counter is selected by the sequence control, events have to happen in a certain order for every function to work properly. First the latch has to be directed to store the current count in the spark counter. This is accomplished with the inverted signal from the sequence control. Once the count is safely stored in the latch, the spark counter has to be reset to zero so it can begin totaling spark pulses for the next three seconds.

It's extremely important for these events to happen in the right order, so we have to guarantee that the count is stored in the latch before the counter is reset. By using a half monostable circuit to trigger the counter reset, there will be enough time for the latch to grab the count before the counter is reset. The width of the half monostable circuits output pulse need only match the 4040's reset requirements (at least 30 nanoseconds with a 5-volt supply), but the RC time must be long enough to ensure proper latch operation (at least 50 nanoseconds with a 5-volt supply). These requirements are easily met by the RC values shown in Fig. 3.

Before you continue with the rest

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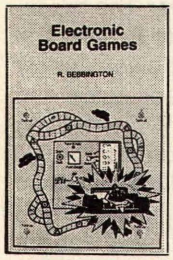

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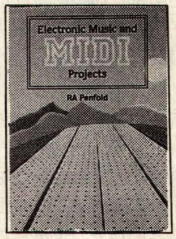

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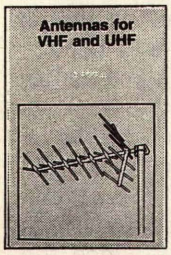

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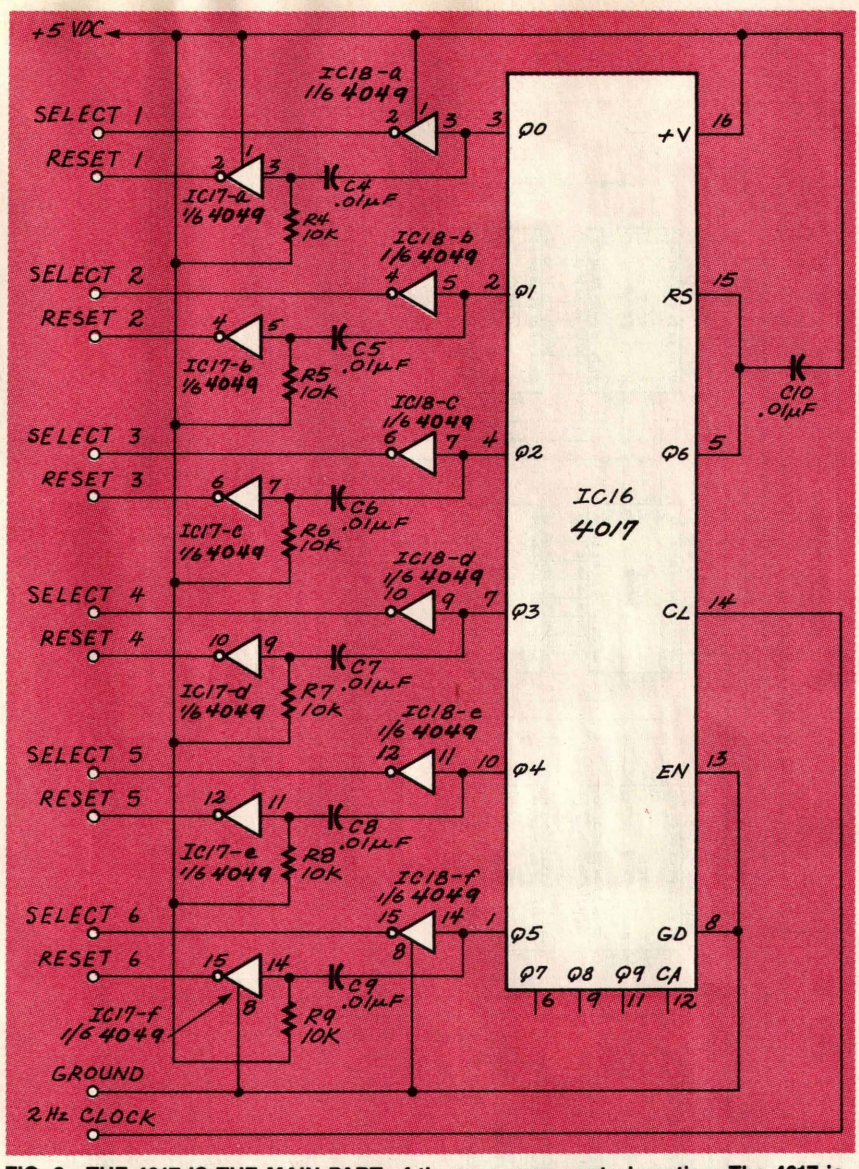
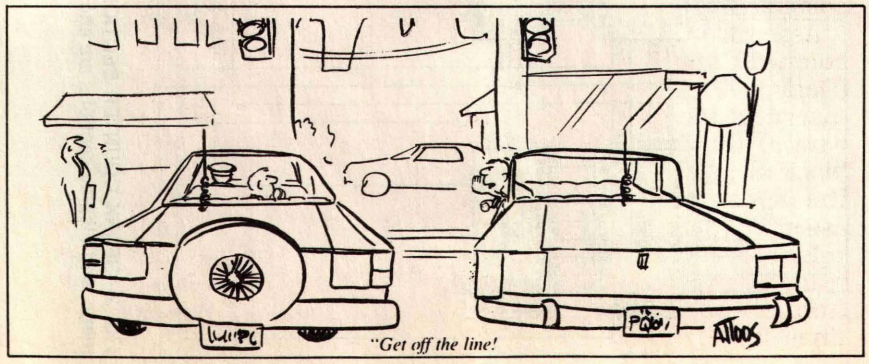


FIG. 3—THE 4017 IS THE MAIN PART of the sequence control section. The 4017 is clocked at an update rate of half a second, or 2 hertz.

of the design, assemble what we've covered so far, and make sure it's working. Check the basic operation of the circuit by feeding the signal input with the 60-hertz output from the 5369 in the timing circuit. If you've used six spark counters, you should get a constant reading of 180 at the latch outputs. With only two spark counters, you should see one second's worth of pulses (60) present at the outputs of the latches. By varying the frequency of the input signal, you should see corresponding numbers at the outputs of the latches. Ω



"Get off the line!

SEMICONDUCTORS

continued from page 60

However, parts submitted for quality conformance inspection per MIL-STD-883, Method 5005, are usually packaged in the more expensive hermetically sealed metal cases and ceramic packages. In addition to receiving stabilization bake, temperature cycling, constant acceleration, visual inspection, burn-in, and other tests, and the parts must be accompanied by pages of traceability documentation—one reason why their unit pricing is so high.

Special tests have been devised above and beyond MIL-STD-883 to account for special or unusual devices. For example, memory devices will be subjected to tests of write/erase cycles and data retention tests.

JAN Class S devices, intended for use in space shuttles, space probes, spy satellites and other critical applications, are tested more exhaustively than military grade parts. Because they are likely to be exposed to radiation, they receive tests for radiation tolerance or "hardness." Ω

CREATING CHAOS

continued from page 51

with wood screws, making sure the assembly is securely fastened and rigid.

Mount the solenoid on the post with the two screws provided. Fasten the circuit board to the shelf of the post with two flathead wood screws. If the wire connections between the solenoid and circuit board are too long, this is the time to unsolder, trim, and resolder them.

Assemble the ball-spring and solenoid shaft adapter block (Details A and B of Fig. 5) by inserting the coiled end of the wire in the drilled holes of the block and threading it through the holes. Snap the completed assembly over the shaft of the solenoid. The Bonker is now ready to give you hours of relief from those monotonous routines of life. Ω

LETTERS

continued from page 29

lose the prestige it once had is still present. Holtzman noted, "Apple is having trouble convincing DOS/Windows users to switch, yet IBM hopes to convert everyone." Well said! Both Microsoft and Sun Microsystems are showing increasing arrogance.

I predict that the transition to NT will not be as Microsoft hopes. I don't know who will win the race for the next-generation operating-system, but I doubt that it will be either NT or OS/2. In my opinion, Unix is still the *de facto* standard for professionals. MS-DOS, NT, and OS/2 are just not in the same league.

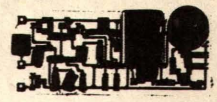
Nevertheless, I acknowledge that MS-DOS is the least expensive and most widely used operating system in the world. That does not, however, qualify it as a technically superior product. Obviously MS-DOS has been a financial success, but that's of no concern to me.

LARRY W. DAUBERT
Garden Grove, CA 92640

It looks as if Mr. Daubert and I are in violent agreement. I wholeheartedly agree that the OS model presented in my article is not a groundbreaker. Nonetheless, it has become a strategic architecture for IBM. How Taligent fits in with either its strategy or the architecture remains to be seen. As for the correspondence between the POSIX model and IBM's, that's IBM's call. I'll just point out that IBM's model covers a much broader spectrum than IEEE's POSIX, which really just confines itself to the Unix world.

I know that the concept of widgets *originated with Project Athena at MIT. I regret that my article was not more forthright on that point.*

Mr. Dauber says IBM, DEC, and Apple have been playing ostrich, and I agree—but so has the Unix world. That is why MS-DOS took over the small computer market. In my opinion, the Unix market had better watch out for NT, and subsequently Cairo. That takeover won't happen overnight, but within five years, a Microsoft operating system could be running everything that matters.—Jeff Holtzman Ω



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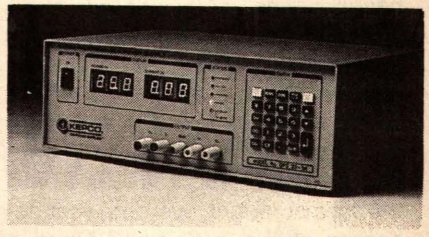

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COMPUTER CONNECTIONS

What is an operating system?

JEFF HOLTZMAN

What is an operating system? What is the difference between "system software" and "application software"? Where do utilities fit? Are there definite boundaries separating the three categories? Does it matter whether there are boundaries at all, and if so, where they are drawn? Is the definition of an operating system a technical one? Is it legal? Is it market-driven? Is it constant, or does it vary over time?

Consult the typical computer reference or textbooks, and you'll see operating system defined pretty much as follows: "The software responsible for controlling the allocation and usage of hardware resources such as memory, central processing unit (CPU) time, disk space, and peripheral devices. The operating system is the foundation on which applications, such as word-processing and spreadsheet programs, are built. Popular operating systems include MS-DOS, the Macintosh operating system, OS/2, Windows, Windows NT, and Unix." (*Computer Dictionary*, 2nd Ed., Microsoft Press, Redmond, WA, 1994).

Most operating system definitions include hardware resource management. But few cover the necessary and sufficient kids of resource management required for software to qualify as an operating system. At the other end of the scale, if you heap more and more software—particularly programs that clearly are applications—onto the core operating system, what becomes of the definition? Does it need to change? Or does a new product category—OS++—need to be defined?

This might all seem academic, except that the company that published the definition given above has products spanning both the operating-system and applications categories. Over the years, Microsoft has continually evolved and expanded its working definition of the operating system to the point that the computer business as a whole has been affected. Ask utility vendors what they think about the inclusion of 386/486 memory-management and file-undeletion tools in recent versions of MS-DOS. Ask network and electronic mail vendors what they think about the inclusion of peer-to-peer networking and E-mail clients in recent versions of Windows.

Some organizations demand that Microsoft be split in half—operating systems and applications. To which side would the 386 memory-management group go? The E-mail group? The file-undelete group? What about the Windows "applet" group (responsible for Write, Notepad, and Terminal)? What about games?

In the definition given earlier, Windows is cited as an example of an operating system. Windows is sold with a popular version of Solitaire; Windows for Workgroups comes with a version of Hearts. Surely games do not help manage system resources—quite the opposite. In fact, their purpose is to expend system resources. What about programming tools? DOS includes DEBUG and QBASIC, which while not state-of-the-art, are certainly capable programming tools.

Suppose you limit the definition to system-resource management software with no user interface. Doing so would, for example, cut MS-DOS down to just two files: IO.SYS and MSDOS.SYS, that together occupy less than 100K of disk space. Doing so would further eliminate COMMAND.COM; the market would then be dependent on third-party offerings such as JPSoft's 4DOS. (Actually, I like that idea. 4DOS is light-years better than COMMAND.COM.) The Unix world has had alternate "shells" for years; why not here in the PC world as well?

In the Windows 3.x world, the limited definition would eliminate all but three Windows executable files, plus some support DLL's. Gone would be Program Manager and File Manager, along with all the mini applications. That might not be such a bad thing either.

On the other hand, including Xcopy and Find and DelTree and all the rest as part of the operating system helps ensure a consistent level of quality and consistency, at least among the core file- and disk-management utilities. Or does it? When was the last time you used DOS's Recover command?

DOS = OS + Utilities

The trend seems to be that the operating system will push higher and higher, further and further away from the hardware. It will be more encompassing in the resources it manages, and it will include more and more in the way of utilities, "applets," and adequate if not full-blown applications.

For example, look at what has happened in the evolution from MS-DOS 3.3 to MS-DOS 6.2. Table 1 lists software that was not included in DOS 3.3 but that is included in MS-DOS 6.2. Every one of those items was originally conceived and sold by a third-party vendor. Most of them are but shadows of their former selves, and some are no longer even with us. Even the biggest utilities vendors (e.g., Symantec/Norton and Central Point) are totally revamping their strategies and product lines.

Microsoft's definition cited both MS-DOS and Windows as examples of operating systems. When you come down to it, MS-DOS manages disk, some peripherals (via a Frankenstein-like kludge of device drivers and TSRs), and memory at a very low level. Almost no programs written to run under MS-DOS use DOS to manage video display or serial communications.

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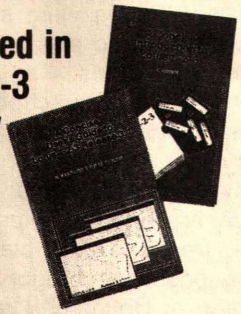

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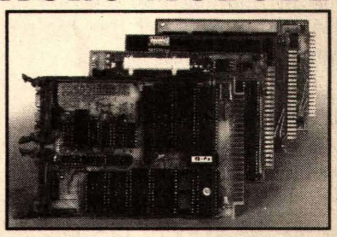

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Windows picks up where MS-DOS leaves off. Together, the two comprise the resource-manager for Intel-based PCs. Together, they include lots of software, utilities, mini-apps, and applications, formerly considered external to the operating system.

OS/2 ratchets the concept a notch higher, as it includes three operating systems (MS-DOS, Windows, and OS/2). And Chicago, though it won't support OS/2, also supports three operating systems, and will likely include even more in the way of utility programs. Outside of the DOS/Intel world, the same kinds of things are happening. New object-oriented operating systems like NextStep and Taligent exhibit the same trend, to an even greater degree.

Growth and expansion is not limited to operating systems. Look at the tools market. A compiler, a linker, and possibly a debugger used to define a programming tool. Now CD-ROM-based programming environments come with fancy screen designers, text and bitmap editors, and huge libraries of precanned routines. Third-party software libraries include complete mini-apps—spreadsheets, word processors, database front ends, communications modules, and more. Such standard applications as word processors occupy 15 megabytes or more of disk space, and they are supplied with all sorts of fancy tools for document design and layout. Application suites (CD-based, of course) are blowing away "single"-function applications.

How big can these things get? Is there a limit to growth? Where do we draw the lines? Share your thoughts; email jkh@acm.org.

On the highway

There are two problems with the so-called information highway as it currently exists: The first is that there are lots of ways to get on the Internet, but few good ones and the second is that once you're on, there is an enormous amount of material to wade through. Many books have been published during the past year or two that purport to help with one or both problems. Surveying this exponentially growing field is beyond my ability, but here are a couple of resources I've run across that might help.

TABLE 1
MS-DOS 6 vs. MS-DOS 3.3

- Disk partitions larger than 32 MB
- Upper-memory management and optimization
- Disk compression
- Usable backup and restore
- Virus scanning
- Disk unformatting
- Serial/parallel-port file-transfer capability
- Boot-file configuration management
- Disk-surface scanning
- Disk defragmentation
- Disk cache
- Power management
- Command-line editing and recall
- System diagnostics

The first is a slim, minimalist book called *The Internet Companion Plus.* If you want to get up to speed quickly on the differences between archie, gopher, and veronica, or learn about the World Wide Web (WWW), or internet addressing conventions, this slim (150 pages) volume can help you do so painlessly. The book includes a floppy disk containing some Internet access software that connects to an Internet service provider called WorldLink. The software is free, but there are connect-time charges.

At the other end of the scale is *The Internet Directory,* a 700-page blockbuster that is more like a yellow-pages directory of what's available where on the Internet. Once you figure out how to get on, this book will be of immense use in finding what you want.

Deeper than *The Internet Com-*

panion Plus is *Internet Basics.* It gives more detail on commands like whois, finger, and telnet. It also has a special focus on accessing the Internet via the Delphi on-line service. Delphi is something like CompuServe or America OnLine; it currently has the most complete Internet access of all the big-name commercial providers.

Editor's bookshelf

Many people these days think that the first personal computer was the Altair 8800. Plans for the Altair were published in the January 1975 *Popular Electronics.* As few people know, however, the real honor goes to *Radio-Electronics,* which published a construction article six months earlier, in July 1974, on the Mark 8 computer. Stan Veit knows that and a whole lot more. For an enjoyable ride through the wild and woolly days of the PC revolution, read *Stan Veit's History of the Personal Computer.* It is a delightful, first-hand account of the growth of the PC industry from the mid 1970s to the early 1980s.

Software and system designers interested in icons that convey meaningful information should check out *The Icon Book,* by William Horton. Horton is a leading authority on user-interface design, online documentation, and related topics. This book distills a lot of research and practical knowledge into a form usable by practitioners, and it includes a set of 500 icons in Windows' format.

For a low-level view of PC video systems, Richard Wilton's *Programmer's Guide to PC Video Systems,* second edition, is an update of one of the true classics in the field. The book discusses details of everything from CGA to SVGA, including memory layouts, register usage, DOS and BIOS calls, VESA BIOS extensions, and many more subjects. Game programmers and device-driver writers will want to master this material. Ω

ITEMS DISCUSSED

The Internet Companion Plus ($19.95), Tracy LaQuey and Jeanne C. Ryer, Addison-Wesley, 1993. ISBN: 0-201-62719-1.
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The Internet Directory ($25), Eric Braun, Fawcett Columbine, 1994. ISBN: 0-449-90898-4.
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Internet Basics ($27), Steve Lambert and Walt Howe, Random House, 1993. ISBN: 0-679-75023-1.
CIRCLE 303 ON FREE INFORMATION CARD

Stan Veit's History of the Personal Computer ($19.95), Stan Veit, WorldComm Press, 1993. ISBN: 1-56664-023-7.
CIRCLE 304 ON FREE INFORMATION CARD

The Icon Book ($39.95), William Horton, John Wiley & Sons, 1994. ISBN: 0-471-59901-8.
CIRCLE 305 ON FREE INFORMATION CARD

Programmer's Guide to PC Video Systems, 2nd edition ($39.95), Richard Wilton, Microsoft Press, 1994. ISBN: 1-55615-641-3.
CIRCLE 306 ON FREE INFORMATION CARD

WHAT'S NEWS

continued from page 79

since late 1993. Tests will continue before a formal product introduction is made in the first half of 1995.

EIA sponsors electronics skills part of VICA competition

The Electronic Industries Association (EIA) and its member companies sponsored the Electronic Product Servicing part of the Vocational Industrial Clubs of America's (VICA) 30th United States Skills Olympics. The competition took place during the VICA National Leadership Conference held on June 30 in Kansas City, Missouri.

The EIA's Consumer Electronics Group (EIA/CEG) Electronic Product Servicing Technical Committee developed, coordinated, and monitored the contest. The Committee members are representatives from member companies including B+K Precision, Matsushita Services Co., Philips Consumer Electronics, Sencore, Sharp Electronics Corp., Sony Electronics, Thomson Consumer Electronics, Toshiba, and Zenith.

The 1994 VICA event attracted more than 3600 vocational students who competed in 54 different trade, technical, and leadership fields. Forty-seven students participated in the product servicing competition, and six winners were selected in secondary and post-secondary school categories.

The secondary school winners were Thomas Harris of Sykesville, Maryland, in first place, Philip Carmichael of Tyler, Texas, in second place, and Edward Neipris of Plainville, Texas, in third place. In the post-secondary category Jonathan Jensen of Bountiful, Utah, Carlos Lovera of Whittier, California, and Timothy Rau of Pocatello, Idaho, finished in that order.

The winners were presented with scholarships that included several $10,000 technical-school scholarships from the National Education Centers and $250 scholarships from the International Society of Electronic Technicians (ISCET).

The prizes included Panasonic, Hitachi and Zenith VCRs, B+K Precision DMMs, Sony and JVC CD/cassette audio systems, and Sony cordless phones and portable CD players. Other prizes were RCA color TV sets, GE answering machine and Snap-On tool kits. One-year subscriptions were awarded to *Electronics Now, Professional Electronics*, and *ES&T* magazines.

Lineman's "third arm"

A robotic arm attached to an electric utility's service truck can stretch over 47 feet and its "hand" can grasp an object, rotate and release it. This "serviceman's third arm," permits line service personnel to trim trees near overhead lines, install and cut wires, and move live wires aside without subjecting them to the dangers of electric shock. By extending the reach of line personnel, it can speed up power line maintenance and the restoration of electric service after an outage.

The robotic arm, which is mounted on a truck like an aerial bucket lift, was developed by Intellisys Automation of Westbury, NY in conjunction with the Long Island Lighting Company's (LILCO) Research and Development group. The truck for supporting the robotic arm was developed by Alabama-based Altec Industries. Ω

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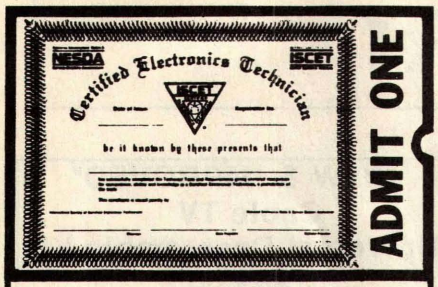

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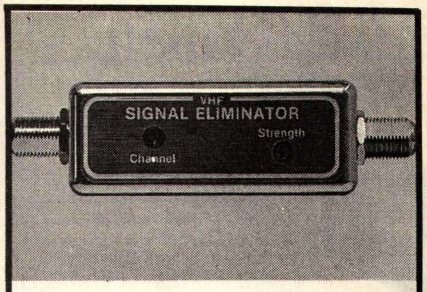

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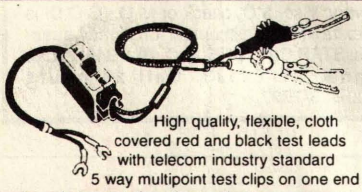

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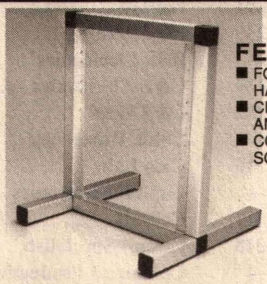
RSB-11	7.5 x 1.65 x 11	51.50
RSB-13	7.5 x 1.65 x 13	58.25



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- CLEAR, BLACK AND GOLD ANODIZED FINISHES
- CONSTRUCTED OF 1.0" SQUARE ALUMINUM TUBING

RACKEM 'N' STACKEM™ **Table Top Racks**

MODEL	DESCRIPTION W x H x D (IN.)	PRICE $
RSR-6	11.4 x 15.2 x 11	60.00
RSR-8	11.4 x 18.8 x 11	65.00
RSR-10	11.4 x 22.6 x 11	70.00
RSR-12	11.4 x 26.4 x 11	75.00
RSR-6-19	20.9 x 15.2 x 11	70.00
RSR-8-19	20.9 x 18.8 x 11	75.00
RSR-10-19	20.9 x 22.6 x 11	80.00
RSR-12-19	20.9 x 26.4 x 11	85.00

NEW

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RACK CHASSIS
PANELS ARE .063" ALUMINUM; STANDARD FRONT AND REAR PANELS ARE CLEAR ANODIZED, BLACK OR GOLD PANELS ALSO AVAILABLEFOR ADDITIONAL $5.00

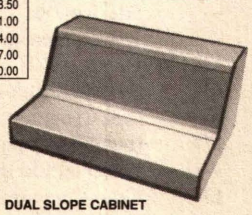
Rack Chassis

MODEL	DESCRIPTION W x D x H (in)	PRICE $
1RU5	19 x 5 x 1.75	34.00
1RU7	19 x 7 x 1.75	36.50
1RU10	19 x 10 x 1.75	38.75
*1RU12	19 x 12 x 1.75	42.75
*1RU15	19 x 15 x 1.75	45.75
*1RU17	19 x 17 x 1.75	48.75
2RU5	19 x 5 x 3.5	36.50
2RU7	19 x 7 x 3.5	38.75
2RU10	19 x 10 x 3.5	41.25
*2RU12	19 x 12 x 3.5	45.25
*2RU15	19 x 15 x 3.5	48.25
*2RU17	19 x 17 x 3.5	51.25
3RU5	19 x 5 x 5.25	46.00
3RU7	19 x 7 x 5.25	48.50
3RU10	19 x 10 x 5.25	51.00
*3RU12	19 x 12 x 5.25	54.00
*3RU15	19 x 15 x 5.25	57.00
*3RU17	19 x 17 x 5.25	60.00

Dual Slope Cabinets

MODEL	DESCRIPTION W x D x H (in)	PRICE $
DS-1	4 x 6 x 4	62.00
DS-2	6 x 6 x 4	66.50
DS-3	8 x 6 x 4	70.75
DS-4	10 x 6 x 4	75.00
DS-5	12 x 6 x 4	79.75
DS-6	18 x 6 x 4	85.00
DS-7	4 x 8 x 6	72.50
DS-8	6 x 8 x 6	76.50
DS-9	8 x 8 x 6	82.00
DS-10	10 x 8 x 6	86.75
DS-11	12 x 8 x 6	92.25
DS-12	18 x 8 x 6	105.75

NEW SIZES



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A NEW MODULAR SYSTEM FOR FAST AND EASY CONSTRUCTION WITH NO TOOLS
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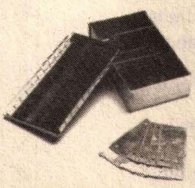

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HOT TIN-PLATED STEEL

RF Shielded Steel Boxes

MODEL	DESCRIPTION L x W x H (inches)	PRICE $
SB-1	2.1 x 1.9 x 1.0	4.50
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SB-3	4.2 x 1.9 x 1.0	9.00
SB-4	6.3 x 1.9 x 1.0	10.50
SB-5	3.3 x 2.7 x 1.1	9.50
SB-6	4.8 x 2.7 x 1.1	11.50
SB-7	6.4 x 2.7 x 1.1	13.20
SB-8	2.6 x 2.7 x .63	7.00
SB-9	3.2 x 2.7 x .63	8.25
SB-10	4.8 x 2.7 x .63	9.00
SB-11	6.3 x 2.7 x .63	10.75
FTS-1	1000 pF/50VDC SOLDER TYPE	.85
FTSI-1	1000 pF/50VDC SCREW-IN TYPE	3.50

PERFECT FOR RF AND CLOCK TYPE CIRCUITS AND ALLOW THE ELIMINATION OF SPILLOVER OF UNWANTED SIGNALS. THE BOXES COME WITH DIVIDERS AND THE LIDS CAN BE SOLDERED TO THE CASE. 1000 pF/50VDC FEED THRU CAPACITORS ARE AVAILABLE AS SOLDER OR SCREW-IN TYPES.

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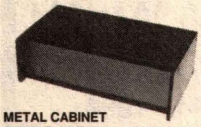
Metal Cabinets

MODEL	DESCRIPTION W x D x H (in)	PRICE $
MC-1A	4 x 3 x 2	17.25
MC-2A	6 x 3 x 2	20.00
MC-3A	8 x 3 x 2	22.00
MC-4A	4 x 4 x 3	20.00
MC-5A	6 x 4 x 3	22.00
MC-6A	8 x 4 x 3	24.25
MC-7A	4 x 7 x 4	22.00
MC-8A	6 x 7 x 4	24.25
MC-9A	8 x 7 x 4	27.00

Heavy Duty Rack Chassis

MODEL	DESCRIPTION W x D x H (in)	PRICE $
3RU7 HD	19 x 7 x 5.25	120.75
3RU10 HD	19 x 10 x 5.25	127.00
3RU14 HD	19 x 14 x 5.25	140.75
4RU7 HD	19 x 7 x 7.0	127.00
4RU10 HD	19 x 10 x 7.0	135.50
4RU14 HD	19 x 14 x 7.0	140.75
5RU7 HD	19 x 7 x 8.75	132.25
5RU10 HD	19 x 10 x 8.75	139.75
5RU14 HD	19 x 14 x 8.75	150.25



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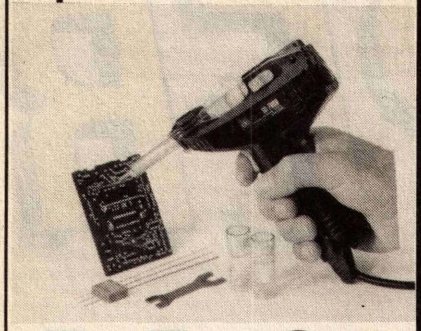

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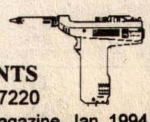

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2N4403 .....5¢
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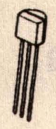

2N4124 .....8¢
2N4126 .....8¢
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MPSA13 ....14¢
MPSA27 ....14¢
MPSA56 ....10¢
MPSA92 ....10¢
MPSH10 ....10¢

2N3055 .....52¢

TIP31C .....40¢
TIP32C .....40¢
TIP117 .....50¢
TIP120 .....50¢
TIP125 .....50¢

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Yellow .....8¢
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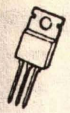

7805.....47¢
7808.....47¢
7812.....47¢
7815.....47¢
7818.....47¢
7824.....47¢
7905.....50¢
7912.....50¢
LM317T ...80¢

78L05.....33¢
78L12.....33¢
Deal 'J1': 10pcs (5 ea of 78L05 & 78L12)....**$3**

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	Solder Tail	Machine Wire Wrap
8 pin	4¢	30¢
14 pin	7¢	54¢
16 pin	8¢	62¢
18 pin	9¢	70¢
20 pin	10¢	78¢
24 pin	12¢	94¢
28 pin	14¢	1.10
32 pin	16¢	1.24
40 pin	20¢	1.56

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LM339 .....45¢
LM358 .....45¢

NE555 .....40¢
NE556 .....45¢
LM741 .....40¢
Deal 'U3': 12 pcs total, (2pcs of each).....**$5**

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1uF/50V .....5¢
2.2uF/50V .....5¢
3.3uF/50V .....5¢
4.7uF/50V .....5¢
10uF/25V .....5¢
22uF/25V .....5¢
33uF/25V .....6¢
47uF/25V .....6¢
100uF/25V .....8¢
220uF/25V .....8¢
330uF/25V .....9¢
470uF/25V ...10¢
Deal 'A9': 60 pcs total, (5pcs of each).....**$4**

1 W ZENER DIODE

1N4728A .....3.3V .....6¢
1N4733A .....5.1V .....6¢
1N4739A .....9.1V .....6¢
1N4742A ..... 12V .....6¢
1N4744A ..... 15V .....6¢
1N4746A ..... 18V .....6¢
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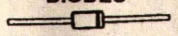
Deal 'V2': 14 pcs total, (2pcs of each).....**$4**

DIODES

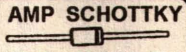


1N914A .....3¢
1N4148 .....2¢
1N4001 ....1A/50V ....3¢
1N4004 ...1A/400V ....4¢
1N4007 ....1A/1kV .....5¢
Deal 'P7': 50 pcs total, (10pcs of each).....**$2**

POWER DIODES

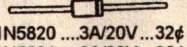
1N5401 ...3A/100V ....6¢
1N5404 ...3A/400V ....7¢
1N5408 ....3A/1kV .....8¢
6A10.....6A/100V ..20¢
6A100.....6A/1kV ...30¢
Deal 'H8': 25 pcs total, (5pcs of each).....**$2**

1 AMP SCHOTTKY



1N5817 ....1A/20V ...20¢
1N5818 ....1A/30V ...23¢
1N5819 ....1A/40V ...24¢
Deal 'Y4': 9 pcs total, (3pcs of each).....**$2**

3 AMP SCHOTTKY



1N5820 ....3A/20V ...32¢
1N5821 ....3A/30V ...36¢
1N5822 ....3A/40V ...40¢
Deal 'Y9': 9 pcs total, (3pcs of each).....**$3**

CERAMIC DISC
(All caps rated 50V)

10pF .....5¢
22pF .....5¢
27pF .....5¢
33pF .....5¢
47pF .....5¢
100pF .....5¢
150pF .....5¢
220pF .....5¢
Deal 'R4': 40 pcs total, (5pcs of each).....**$2**

Toggle Switches

Miniature size 1/4" Panel hole
on-on .....SPDT ....60¢
on-on .....DPDT ....68¢
on-off-on ...DPDT ....85¢
Deal 'S7': 6 pcs total, (2pcs of each).....**$4**

TANTALUM CAPS

1uF/35V .....18¢
2.2uF/35V ....20¢
10uF/35V .....35¢
Deal 'T6': 15 pcs total, (5pcs of each).....**$3.50**

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1N34A .....10¢
1N60 .....10¢
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270pF .....5¢
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.022uF .....5¢
.047uF .....6¢
.1uF .....6¢
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Deal 'W5': 100pcs total, (20pcs ea. above).....**$2**

MONO CAPS.....5¢ea

.01uF/50V .047uF/50V
.022uF/50V .1uF/50V
Deal 'B5': 40 pcs total, (10pcs of each).....**$2**

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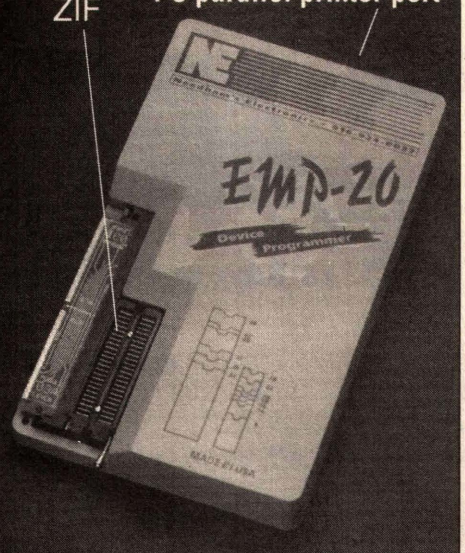

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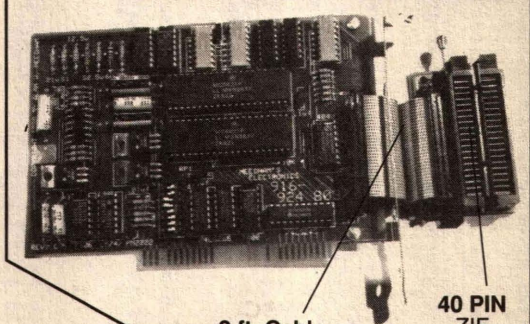

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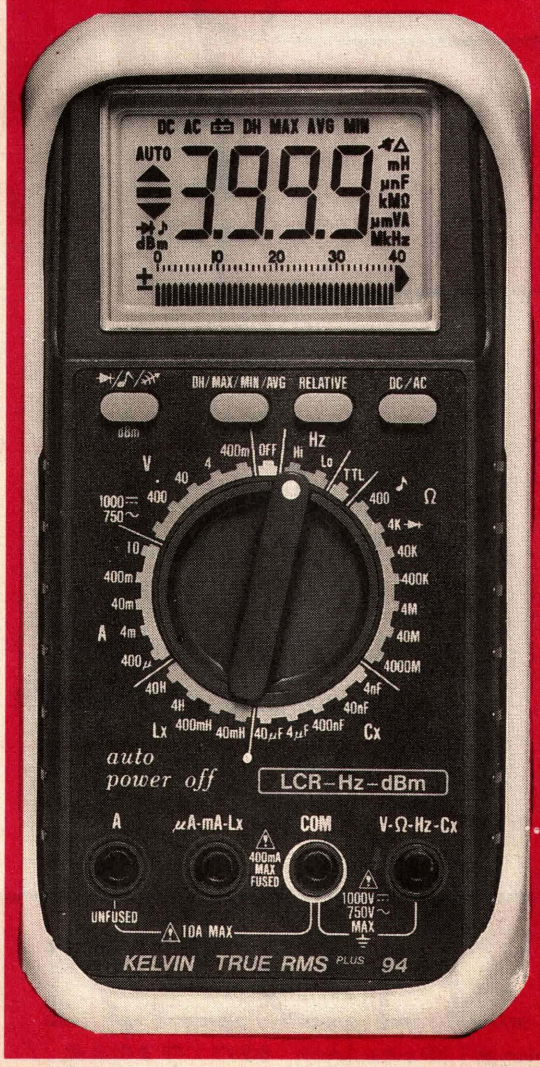

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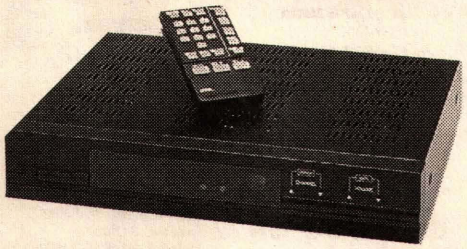

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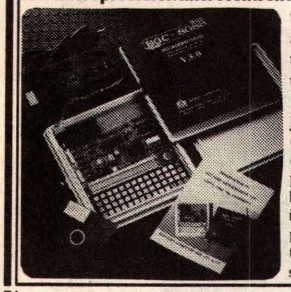


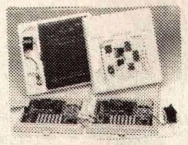
BGC-8088 only $699.00 8088 Trainer.

Features: Assembly language coding, assembler, disassembler, single step and multi-breakpoint program debugger, display and rewrite registers, download/upload programs from/to external systems, I/O drivers, 56-key large size keyboard, LCD display, RS-232, UART, printer interface, two expansion slots, ±5V, ±12V switching power supply, user's guide and experiment guide, Practical control applications available, such as servo and stepping motor, dot matrix display, D/A, A/D, sensors, ...

BGC-8052 $979.00 It helps you learn the most powerful and popular Intel 8051/8052 Embedded Microcontroller in today's appliance control industries.

U-DBGR $1599.00 Universal Debugger/In-circuit Emulator for commonly used Microprocessors, such as 6502, Z80, MCS-48, MCS-51, 8088, .. etc.. Trace & debug program, EPROM programmer, DOS Shell. Can be operated with BGC-8088 or IBM PC/compatible.

APEX-IE 8052 $699.00 In-Circuit Emulation Training Systems for 8051/8052. It helps you understand microprocessor based control circuit design, troubleshooting, assembly language programming and debugging. Can be operated on BGC-8088 or IBM PC/compatible.



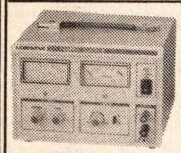
EDS-8809-1 $589.00 IBM PC/compatible(add an adapter $99.00) and BGC-8088 I/O control applications include 24 experiments, such as stepper motor control and simulation, digital clock, speaker control, dot matrix LED control , Matrix keyboard, sign lights, 8255 polling handshakes, electric piano, stop watch,.. more.

CIC-100 $549.00 IBM PC/compatible I/O control applications, learn Assembly, C, and BASIC programming languages, 800-pin solderless breadboard for circuit design andtest, I/O drivers for controlling relay, step motor, LED, speaker, sensor, ..etc.. Experiment manual. Application control modules available, including step motor, matrix key-pad, traffic light, A/D, D/A, F/V, V/F converters, sensors, etc.

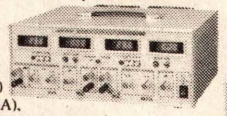
EDS-8804 $239.00 A/D and D/A converter applications for BGC-8088 or IBM PC/compatible.

EDS-8805 $479.00 Servo motor and stepper motor control for BGC-8088 or IBM PC/compatible.

DC POWER SUPPLY



PS-303 $159.00
0-30VDC, 0-3A; 0.02%+2mV line regulation; 0.02%+3mV load regulation; 1mVrms noise & ripple; Short circuit/overload protection; constant current/voltage(CC/CV).
PS-303D $314.95 dual outputs.
PS-305 $219.95, 0-30VDC, 0-5A.
PS-305D $399.95, dual outputs, over load protection.

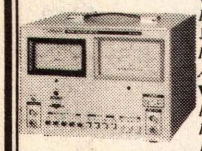


8110 $289.95
0-60VDC, 0-3A.
8112 $399.95
0-60VDC, 0-5A.
8108(8109) $549.95($699.95) dual output, 0-60VDC, 0-3A(5A), independent tracking operation. Low ripple.
8102(8103) $399.95($489.95) dual 0-30VDC/0-3A(5A), fixed 5VDC/3A, indepedent tracking operation, constant voltage and current. Slave/Master, Serial/Parallel connection.
PS-1610S(8107) $289.00($399.95) 0-16VDC, 0-10A.
PS-2243(2245) $139.00($159.00) 0-12/0-24VDC,3A(5A).
8200(8201) $179.95($239.95) 0-30VDC, 0-3A(5A).
8202(8203) $499.95($549.95) 3 outputs, digital display, dual 0-30VDC/0-3A(5A), fixed 5VDC/3A, indepedent tracking operation, constant voltage and current.

AM/FM SWEEMAR SCOPE

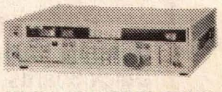
SM-6225B/C $1999.95
Freq Range: (AM)490KHz; (FM) 10-11.4MHz; *Acuracy*: ± 0.1%
Marker: (AM)455KHz, ±5KHz, ±10KHz; (FM)10.7MHz, ±7.5KHz, ±150KHz.

WOW-FLUTTER METER



WF-3103 $699.95
Freq. Range: 3KHz±10% JIS/CCIR; 3.15KHz±10% DIN.
Range: 0.03/.1/.3/3% full scale.
Accuracy: ±5%.
WF-3105A $799.95, digital;
Function: LIN/WOW/Flutter/WTD.
Freq Cntr: 10Hz-9.99MHz.
Indication: CCIR/DIN/JIS.

AM/FM STD SIGNAL GEN.

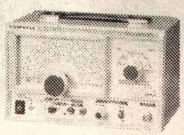


SG-4110A $1799.00
Freq: 100KHz-110MHz
Display: 6-digit LED
Accuracy:
<=±(5x10-E5 ±1 count)
Resolution:100Hz (100-34.99MHz); 1KHz (35MHz-110MHz).
Output Range: -19dBu, -99dBu, 1dB step
Impedence: 50 Ohm VSWR 1.2.

AC MILLIVOLT METER

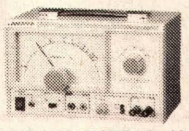
MV-3100A $159.95 wide band 5Hz~1MHz; 3 scales, mV, dB, &dBm; 300μV~100V in 12 ranges, 10μV resolution; -70~40dB in 12 ranges, 0dB=1Vrms, 0dBm=0.755V); ±3% accuracy; Input impedence 10MΩ; Noise <2%.
MV-3201B $309.95 dual channels, simultaneous measurement.

RF SIGNAL GENERATOR



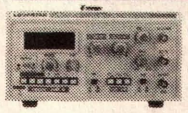
SG-4160B $119.00
100KHz-150MHz up to 450MHz on 3rd harmonics; 6 ranges; AM modulation.
RF Output: 100mVrms to 35MHz.
Modulation: Int. 1KHz AM, Ext. 50Hz-20KHz AM.
Audio Output: 1KHz, 1Vrms.
SG-4162AD $229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals.

AUDIO GENERATOR



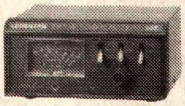
AG-2601A $119.00
10Hz-1MHz, 5 ranges;
Output Level: sinewave 0-8Vrms, square 10Vp-p.
Output Impedence: 600 Ohm.
Distortion: <0.05% 500Hz-50KHz; <0.5% 50KHz-500KHz.
AG-2603AD $229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals.

FUNCTION GENERATOR



FG-2100A $169.95
0.2Hz-2MHz in 7 ranges; Sine, Square, Trianle, Pulse & Ramp
Output: 5mVp-p-20Vp-p, 1% distortion.
VCF: 0-10V control freq. to 1000:1.
FG-2102AD $229.95 generates signals same as FG-2100; 4-digit counter display, TTL & CMOS outputs, 30ppm ±1 count accuracy.
FG-2020B $159.00 0.5Hz-500KHz; Sine, Square, Triagle.
(FG)2103 $329.95, Digital sweep generator, 0.5Hz-5MHz in 7 ranges.
Operating Mode: sweep, AM, gated burst, VCG.
Freq. Counter: Int. 0.5Hz-5MHz; Ext. 5HZ-10MHz.

SWR/RF POWER METER



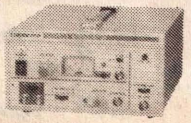
310 $89.95
Freq.Range: 1.8-150MHz.
RF Power: 0-4W/20W/200W
SWR Measure.:1.0 - ∞, 4W min.
Accurcy: 5%-10%; SO-239 plugs.
Insertion Loss: 0.3dB.
Input/Output Imp.: 50Ω.

320 $89.95, 130-520MHz.
330 $119.95, 1.8-520MHz.

SWR-3P $26.95
1.7-150MHz;
RF Power: 0.5-10W, 0.5W-100W.
SWR-2P $22.95, 1.7-30MHz; *RF Power*: 0.5-10W.
PM-330 $136.00 1.8-500MHz; 0-5W/20W/120W.

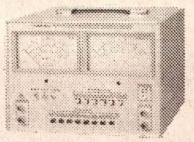
FM STEREO MODULATOR

AG-2011A $549.00
RF SECTION: *Carrier*: 98MHz ±2MHz;
Output: 10mV, 1mV & 0.1mV
COMPOSITE SIGNALS:
Pilot: 19KHz ±2Hz, 0.8Vrms
INT. MODULATION:
400KHz, 1KHz ±1%,
1Vrms, distortion: < .5%
L-R Seperation: >50dB.
EXT. MODULATION: *Freq.*: 50Hz-15KHz
L-R Seperation: >45dB 100Hz-3KHz; >35dB 50Hz-15KHz.

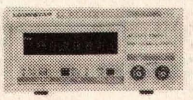


AUTO DISTORTION METER

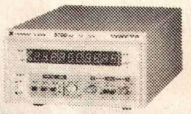
DM-3104A $799.95
MEASUREMENT:
Range: 0.01%-30%, 0.1/0.3/1/3/10/30% full scale.
Freq.: 400Hz±10%, 1000Hz±10%(HPF).
Input: 3mV-100V, ratio measuring 20dB.
Auto. Switching Ranges: Fundamental Freq. = (fo)±10%; Fund. Rejection: >-80dB at (fo)±5%; >-70dB at (fo)±10%.
Harmonic Accuracy: ±0.5dB, 1.8(fo)-20KHz.



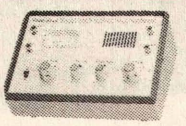
FREQUENCY COUNTER



FC-5250C $119.95
Freq. Range: 10Hz-220MHz (HF)10Hz-20MHz, (VHF)10MHz-200MHz
Gate Time: 0.1 & 1sec.
Max. Input: 10Vp-p.
Input Sensitivity: 35mV 10Hz-200MHz.
Input Imped.: (HF) 1MOhm, (VHF) 50Ohm.
FC-5260A $146.00
10Hz-600MHz.
FC-5270A $149.95
10Hz-1300MHz.
FC-5600B $321.00
10Hz-600MHz.
(FC)5700B $329.95 10Hz ~ 1.3GHz.



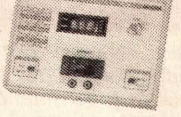
SIGNAL TRACER/INJECTOR



SE-6100 $134.95
TRACER: Gain Max. 60dB
Attenuation: 0/20/40/60dB
Input Imped.: 100KOhm
Output Imped.: 600Ohm;
Speaker: 8 Ohm.
INJECTOR: *Freq.*: 1KHz Squarewave; *Output Level*: Continuously variable 0 - 4.5Vp-p.

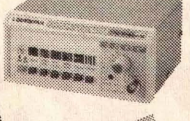
AUTO. CAPACITANCE METER

CM3300A $139.00
10 ranges, 99.9pF ~ 99.9mF, fully automatic.
Resolution: 0.1pF lowest, 0.1% full scale.
Accuracy:
0.5% of full scale±1digit to 99.9μF,
1% of full scale±1digit to 99.9μF.
Display: 3 digit LED.
Unit indicator: pF, nF, μF, mF. Overrange indicator.



TV COLOR PATTERN GEN.

CPG-1366A $159.95
VHF NTSC;
Freq.: 45.75, 175.25, 187.25 Mhz.
RF Output: 10mV.
Impedence: 75 Ohm;
Video Output: BNC, 1Vp-p.



GRID DIP METER

DM-4061A $89.95
1.5-250MHz, 6 bands; 6 plug-in coils, 2 transistor, and 1 diode.
Modulation: ≈ 2KHz Sinewave.
Crystal Oscillator: 1-15MHz.
Using 9VDCpower supply.

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Get the Best Universal Diagnostics Toolkit on the market!

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Featuring these two top-rated, award-winning diagnostic tools from MICRO 2000, Inc:

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1993 BYTE POURNELLE'S USER'S CHOICE AWARD

"You name it, this tests it. If you maintain PC's, you'll love it."
—Jerry Pournelle, BYTE Magazine, May 94

PC UPGRADE UTILITY OF THE MONTH

SERVICE NEWS PRODUCT OF THE MONTH

Micro-Scope™

UNIVERSAL DIAGNOSTICS SOFTWARE Ver. 5.0

Fully O/S independent diagnostic software...

MICRO-SCOPE Universal Computer Diagnostics was developed to satisfy the expanding need for accurate system diagnosis in the rapidly growing desktop computer market. Patterned after super-mini and mainframe diagnostic routines, MICRO-SCOPE runs independently of any standard operating system, and is therefore at home on any machine in the Intel world. Speed, ease-of-use, and razor sharp accuracy are a few of the advantages that arise from this system independence, together with an impressive list of functions including the ability to perform low level formatting on every drive currently manufactured, including all IDE drives.

● **LOW-LEVEL FORMAT** — Performs Low-level format on all drive types including IDE drives. This function cannot hurt IDE drives. ● **USE CONTROLLER BIOS** — Program will access BIOS format built into any hard disk controller—even Controllers yet to be invented. ● **O/S INDEPENDENT** — Does not rely on O/S for diagnostics. Talks to PC on hardware level. All tests are full function regardless of O/S (i.e. Novell, UNIX, OS/2). ● **TRUE HARDWARE DIAGNOSTICS** — Accurate testing of CPU, IRQ's, DMA's, memory, hard drives, floppy drives, video cards, etc. ● **BATCH CONTROL** — All tests, even destructive, may be selected for testing. ● **ERROR LOGGING** — Automatically inputs errors during testing to an error log. ● **AUTOMAPPING** — Automatically bad sector maps errors found on hard disks. ● **IRQ DISPLAY** — Show bits enabled in IRQ chip for finding cards that are software driven. (Network, Tape Backup, etc.) ● **IRQ CHECK** — Talks directly to hardware and shows I/O address and IRQ of devices that respond. ● **MEMORY EXAMINE** — Displays any physical bit of memory under 1 Meg. Very useful for determining memory conflicts. Very useful for determining available memory space. ● **SECTOR EDITOR** — Allows the editing of any sector of floppy or hard disk media (even track 0). ● **AND MUCH MORE...**We don't have enough space here for everything this software can do!

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1ST EVER UNIVERSAL POST CARD FOR ALL PC's!

The only Power-On Self-Test card you need to debug any "dead" PC...

"This is the only card that will function in every system on the market. The documentation is extensive, and not only covers the expected POST Codes for different BIOS versions, but also includes a detailed reference to the bus signals monitored by the card." —**Scott Mueller** from his globally recognized book, ***'Upgrading & Repairing PCs, Second Edition'***

● Includes pads for voltmeter to attach for actual voltage testing under load. ● 4 LEDs monitor +5vdc -5vdc +12vdc -12vdc. ● Monitors Hi & Lo clock and OSC cycles to distinguish between clock chip or crystal failure. ● Monitors I/O Write and I/O Read to distinguish between write and read errors. ● Monitors memory write/ read to distinguish between address line failures and memory chip failures. ● Monitors ALE for proper CPU/DMA operation. ● Monitors Reset to determine if reset is occurring during POST, indicating short. ● Monitors progress of POST *without* POST codes. ● Reads POST codes from any IBM or compatible that emits POST codes. ISA/EISA/MCA. ● Compatible with Micro Channel computers. ● Dip switch allows easy selection of I/O ports to read. ● Includes tri-state **LOGIC PROBE** to determine actual chip failures. ● Manual includes chip layouts and detailed POST procedures for all major BIOS's. ● **AND MUCH MORE...** **This is the perfect toolkit for all repair technicians and self-maintainers. Call MICRO 2000, Inc. for further technical details or after sales service!**

MICRO 2000

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CIRCLE 327 ON FREE INFORMATION CARD

CircuitMaker® vs. Electronics Workbench®

A NEW STANDARD HAS JUST BEEN SET !

State-Of-The-Art Analog Simulation

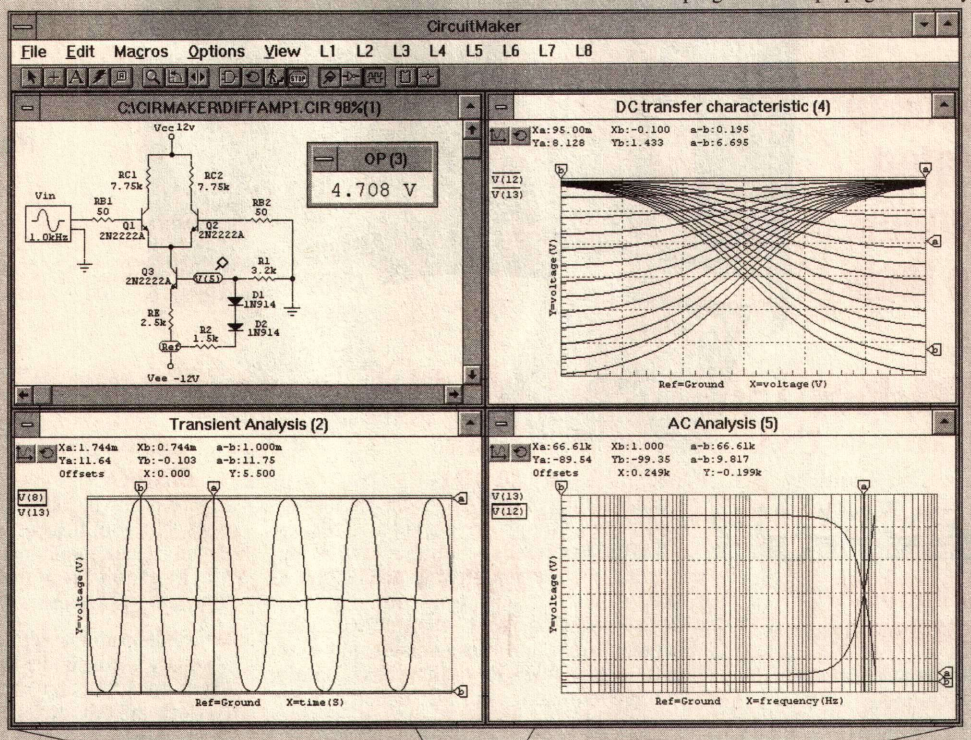
CircuitMaker's analog simulation results are shown in graph windows that provide powerful, interactive analysis options. You can plot multiple waveforms by clicking on the desired nodes and can select linear or logarithmic axes. Horizontal and vertical cursors facilitate quick and accurate measurements. You can also zoom in on any portion of the graph to obtain additional detail.

Electronics Workbench offers a single, small scope or Bode plot instrument window. The windows are not sizeable and only two waveforms can be plotted at a time. EWB has a single measurement cursor and provides no direct way to read results from the instruments.

Superior Digital Simulation

CircuitMaker has an exclusive Trace feature where the state of every node is indicated in color as the simulation runs. You can monitor as many waveforms as your screen will allow, set edge or level breakpoints for analysis, and interactively see the state of any node by touching the logic probe to it. The data sequencer provides 1024 words of pattern data. Additional digital instruments include ASCII and HEX input keys and an ASCII display. CircuitMaker includes tri-state devices and devices have programmable propagation delays.

Electronic Workbench has no interactive logic probe or Trace capability and no Hex or ASCII keys. Their "word generator" is limited to 16 words. EWB does not have tri-state devices and digital devices do not have programmable propagation delays.



Comprehensive Device Libraries

CircuitMaker includes libraries containing programmable, TTL, CMOS, generic analog and digital devices, and many powerful I/O devices. With CircuitMaker's macro function you can quickly and easily create your own functional devices and symbols. Now that's giving you the tools you need to get the job done right!

Electronics Workbench ships with only 17 digital devices. If you want additional devices you pay extra.

Competitive Upgrade Offer

You deserve the best. Upgrade from any competing product for only $99. New users can purchase CircuitMaker for a limited time at a special introductory price of just $269. Suggested Retail Price $299.

High-Performance Schematic Capabilities

CircuitMaker puts you in control of your schematic with SmartWires™, bussing, page connectors, and rubberbanding. You can label devices and pins, add fully stylized multiline text, and create a parts list or netlist. With the Macro feature you can add user defined symbols to your device library.

Electronics Workbench dictates wire placement to you. EWB limits your overall "workbench" layout to 1 x 2 pages. EWB has no bussing, page connectors, pagebreaks, print scaling, labeling, free text fields, netlisting, zoom, undo, and no Toolbar or Toolbox.

Technical Support

MicroCode Engineering offers free phone support from knowledgeable engineers. And, you won't find yourself listening to music when you call for help.

Interactive Image Technologies offers 3 free calls and then you have to pay for all subsequent calls.

Comparison based on CircuitMaker 2.0 for Windows and Electronics Workbench 3.0 for Windows. All product and company names are trademarks of their respective owners.

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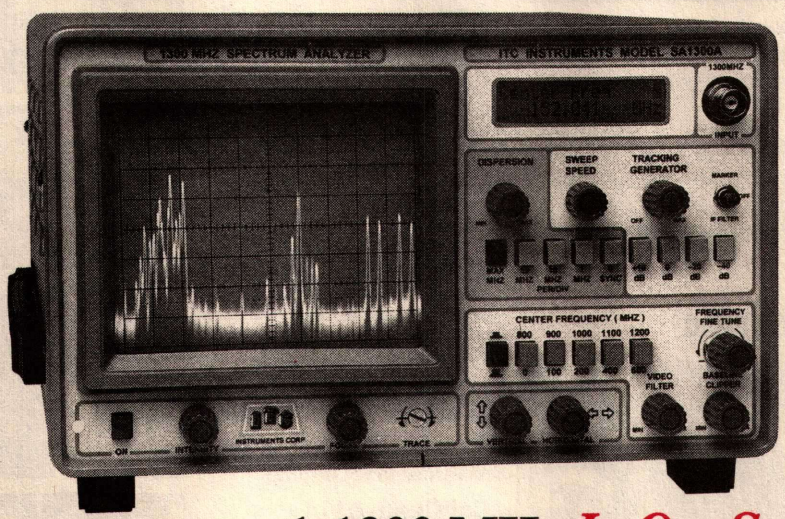
500 MHz *SPECTRUM ANALYZER* $895.

MADE IN THE USA ITC SA500A is a full function Spectrum Analyzer covering all Ham Radio, Two way Radio, TV, & CATV frequencies bands to over 500 MHz. * Add Opt. 3 Narrow Band Filter for only $200 and the SA500A becomes a full range *Pan Adapter /Spectrum Display Monitor** The SA500A Includes Center Frequency Display, 50 MHz Marker Generator, 50 MHz Tracking Generator, -100 dB Dynamic Range, 80dB on Screen, and -100 dBm Sensitivity.



INTRODUCTORY OFFER

SA500A With Center Frequency Display, 500 MHz Tracking Generator plus 50 MHz Marker Generator
ONLY $895.00 *

SA1850S Covers 850 to 1850 MHz in One Sweep, LNB Power Supply, 110/220/12vdc/Battery Operation, Carring Case Center Freq. Display. The lowest cost Satellite Analyzer avaible.
ONLY $1295.00*

SA1300B & OPT.s 1, 3, 4, 6
ONLY $1895.00*

SA1800C & OPT's 1, 3, 4, 6
ONLY $2295.00*

SA600A	$1295.00
SA1300B	$1595.00
SA1800C	$1895.00
OPT. 1 50MHz Marker Generator	$200.00
OPT. 3 +/- 5KHz Res. B. W. Filter	$350.00
OPT. 4 12 VDC Inverter Adapter	$100.00
OPT. 5 1000 MHz Tracking Generator	$250.00
OPT. 6 7 Digit Center Frequency Display	$300.00

* Note: Introductory Prices for limited time only

AS SHOWN **1-1300 MHz *In One Sweep* $1,895.**

MADE IN USA +/-5KHz Resolution Band Width - 7 Digit Center Freq. Display - 12vdc operation -110 dBm Sensitivity, 120 dB Dynamic range, **80 dB** ON SCREEN, Exclusive *DISPERSION ZOOM* Allows scan widths 0 MHz to 1300 MHz at any Dispersion preset stop, Total flexibility and ease of operation.

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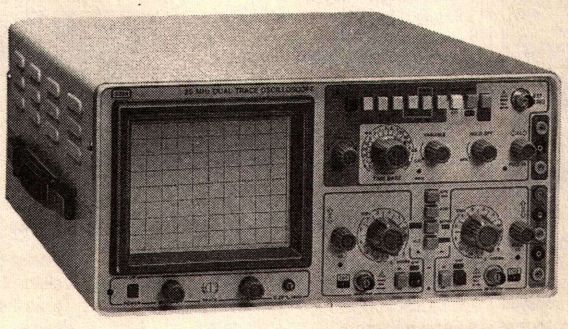
25 MHz Dual Trace w/ 3 in 1 TestLab $429.
+5/1A, +/-12V/.2A DC Outputs Dual Component Tester

25 MHz Dual Trace $339.
40 MHz Dual Trace Delayed Sweep $549.



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(intensity modulation)
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Dual Component Compartor
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+5 / 1A, +/- 12 /.2A
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***ProGold** and **DeoxIT** increase the performance and reliability of electrical components and equipment. They provide long-lasting protection, reducing the expense of repeated cleaning with expensive ozone-depleting solvents. As a general rule, use **ProGold** for best performance and protection on plated surfaces and **DeoxIT** as a general purpose treatment.*

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ProGold outperforms all other contact cleaners, enhancers and lubricants. Due to its unique properties, not only does it deoxidize and clean surface contamination, but it penetrates plated surfaces and molecularly bonds to the base metals. This increases conductivity and contact surface area and reduces arcing, RFI, wear and abrasion - the major cause of intermittent signals, distortion and signal loss. ***ProGold** is the only product that conditions & protects plated surfaces and their base metals.*

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Deoxidizes, Seals & Protects Electrical Connections

DeoxIT is a fast-acting, deoxidizing solution that cleans, preserves, lubricates & improves conductivity on all metal surfaces. Use as a general treatment for connectors, contacts & other metal surfaces.

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OpticALL™ StaticALL™

OpticALL cleans, polishes and eliminates static electricity on optical viewing surfaces. OpticALL is also recommended as a general purpose antistatic cleaner on plastic, glass and metal surfaces. **StaticALL** neutralizes static build-up caused by friction & low humidity conditions. Use on carpets, floors, clothing & other static generating surfaces.

DustALL™ FreezALL™

DustALL quickly & safely removes dust, lint & particles from sensitive electronic equipment, computers, lab equip., optical grade surfaces & other mechanisms & equipment. **FreezALL** quickly and safely cools circuits to -54°C. Locates intermittent components due to heat failure and hairline cracks on PCBs.

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High Penetrating Anti-Corrosive Anti-Tarnishing Cleaner & Lubricant. Lubricates & Protects, Displaces Moisture, Stops Squeaks, Migrates & Coats Entire Surface.

ElectricALL™

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CaiKleen™ 41

Approved Freon TF replacement. Cleaning solvent for equipment and parts. Harmless to metal and most plastics & elastomeric parts. No residue, non-flammable, HCFC blend.

CaiKleen™ TRP

For degreasing, cleaning & defluxing equipment and parts. Removes oil, grease, dirt and contaminants including rosin flux from PCBs, components and metal parts. Biodegradable.

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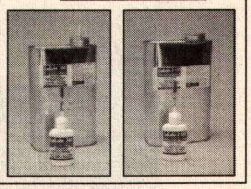
Ultra-pure isopropyl alcohol. Cleaning & degreasing solvent for removal of oil, grease & dirt from instruments, equipment & parts. Use on tape heads, discs, guides, switches, connectors, relays, and other parts for general cleaning.

CaiLube™ 360

Finest quality cutting and lubricating oil for use on various materials; cast-iron, stainless, titanium, gold, platinum, non-ferrous metals, synthetics, etc..

CaiLube™ X-10S Instrument Oil



Contains silicone. Finest quality instrument oil for use on rubber, plastics and metals. Non-gumming, rust inhibiting, long lasting lubrication.

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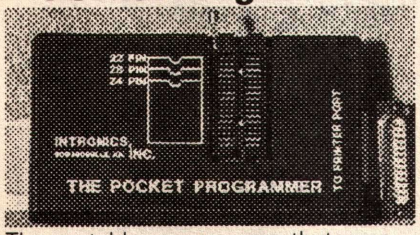
CIRCLE 135 ON FREE INFORMATION CARD

Only $129.95 for The Pocket Programmer



The portable programmer that uses the printer port of your PC instead of a internal card. The software has 24 functions and programs (E)Eprom, Flash & Ram 27/28(C)XXXX from 16K - 8 Megabit with a 32 pin socket. Adapters availble for 874X, 875X MCU's, 40-Pin & Serial Eproms and Eprom Emulation to 32K X 8.

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The Only Eprom programmer made for Macintosh. The software has 15 functions including File Editing with a 32-Pin socket supports (E)Eprom, (27/28(C)XXX) and Dallas Ram from 16K - 4Megabit. **Only $299.95**

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Test your Logic circuits with the printer port of your IBM or compatible computer!

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- ☑ Glitch capture and display
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- ☑ Automatic time base calibration
- ☑ 4 cursors measure time and frequency
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The Real Logic Analyzer is a software package that converts an IBM or compatible computer into a fully functional logic analyzer. Up to 5 waveforms can be monitored through the standard PC parallel printer port. The user connects a circuit to the port by making a simple cable or by using our optional cable with universal test clips. The software can capture 64K samples of data at speeds of up to 1.2uS (Depending on computer). The waveforms are displayed graphically and can be viewed at several zoom levels. The triggering may be set to any combination of high, low or Don't Care values and allows for adjustable pre and post trigger viewing. An automatic calibration routine assures accurate time and frequency measurements using 4 independent cursors. A continuous display mode along with our high speed graphics drivers, provide for an "Oscilloscope-type" of real time display. An optional Buffer which plugs directly to the printer port is available for monitoring high voltage signals.

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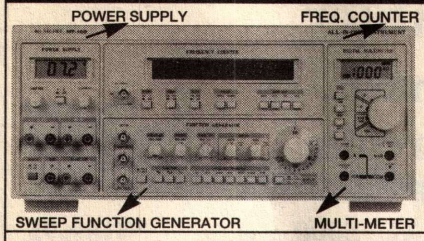


MT-100

Reg. $599.

$399.00

Four Instruments in One Instrument

1 Function Generator
- Sine, Square, Triangle, Pulse, Skewed Sine, Ramp, TTL
- 0.2 Hz ~ 2MHz

2 Frequency Counter
- 8 Digit LED
- 1 Hz ~ 100MHz
- ± (1 Hz + 1 dgt. + Time Base Error)

3 Power Supply
- 3-1/2 Digit LCD
- Triple output: #1. 0~50V, 0.5A MAX #2, 15V, 1A #3. 5V, 2A

4 Digital Multimeter
- 3-1/2 Digit LCD
- DCV, ACV, Ω, DCA, ACA
- ± (0.5% + 2 dgts)

FG-140 2MHz Function Generator

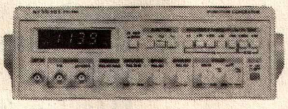
Reg. $249. **$149.00**

- 0.2 Hz ~ 2.0 MHz, 7 Decades
- Sine, Square, Triangle, Pulse, Ramp, Skewed Sine
- VCF, Symmetry
- Variable DC Offset Control

2MHz Sweep Function Gen. w/Freq. Counter

FG-150

Reg. $399. **$229.00**

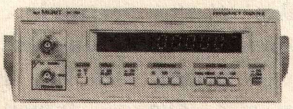


- 4 Digit LED Display
- Sine, Square, Triangle, TTL, Pulse, Ramp, Skewed Sine
- Linear/Logarithmic Sweep
- 10 MHz Freq. Counter

1.0GHz Frequency Counter, High Resolution

FC-200

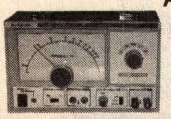
Reg. $399. **$209.00**



- 1.0 Hz ~ 1.0 GHz
- 8 Digit LED Display
- Auto & Manual Range
- 4 Selectable Gate Times
- 1MΩ & 50Ω Input Impedance

AG-350 Audio Generator

Reg. $199. **$119.00**



- 10 Hz ~ 1 MHz, 5 Ranges
- Sine Output: 10Hz - 1MHz
- Square Output: 10Hz - 100KHz

PS-500 DC Power Supply

Reg. $249. **$159.00**

- 0 - 30 VDC
- 0.1 ~ 3A
- Short & Overload Protection

PS-540 DC Power Supply

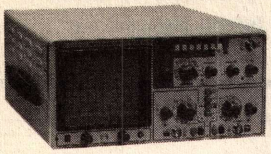
Reg. $399. **$289.00**

- 0 - 16 VDC
- 0.1 ~ 10A
- Short & Overload Protection

Deluxe O'scopes w/Phillips CRT. 2 yr. Parts/Labor Warranty

OS-3304

Reg. $499. **$339.00**



OS-3324

Reg. $599. **$399.00**

OS-3344

Reg. $899. **$649.00**

OS-3304 25MHz, Dual Trace

- 1 • DC to 25 MHz. Dual Channel
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 20V/div X-Y modes, Z Axis (intensity modulation)
- Rise time 14n Sec. or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 2kV
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

OS-3324, 3 Function

- 1 • OS-3304
- 2 • Dual Component Tester/Comparator
- 3 • Triple DC Power Supply 5VDC, +12 VDC, -12VDC

OS-3344, 5 Function

- 1 + 2 + 3 • OS-3324
- 4 • Frequency Counter 100MHz, 7 Digit LED Display
- 5 • Function Generator 0.02 Hz to 2.0 MHz

OS-3315 40MHz, Dual Trace Sweep Delayed

Reg. $799. **$549.00**

- DC to 40 MHz. Dual Channel
- Delayed Sweep 100nS to I.O.S. 7 decade
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 20V/div X-Y modes, Z Axis (intensity modulation)
- Rise time 8.5nS or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 12kV
- Variable Hold Off
- 16ns ~ 1.0s Time Base
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

Capacitance Meter

Reg. $79. **$49.00**

CM210

- 3 1/2 Digit LCD
- 0.1p - 20.000μF 9 Ranges
- 0.5% basic Accu.
- Zero Adjust Knob

Digital Clamp-On

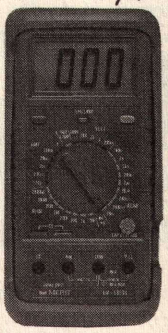
Reg. $89. **$54.00**

DA400

- 400 Amp AC
- 3 1/2 Digit
- Auto
- Data Hold
- Continuity
- Over Range Mark
- Case Included

Multimeter+ Extended Range Capacitance

Reg. $149. **$89.00**

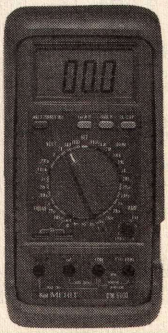


DM5050C

- 9 Function / 42 Range
- Basic DCV Accu.: ± 0.25%
- Multimeter Volt: AC/DC Amp: AC/DC 2A Ohm: Up to 2000MΩ Diode, Continuity Beeper
- Capacitance (9 Range) 0.1pF - 20,000 μF Zero Adj. Knob
- Trig Lamp
- Double Insulated Jack
- Alligator Clip Test Leads
- Deluxe Holster w/Strap

Wide Range Multimeter w/Logic

Reg. $149. **$89.00**



DM5100

- 11 Function / 45 Range
- Basic DCV Accu.: ± 0.25%
- 3 1/2 Digit Manual
- Auto Power Off
- Data Hold & Peak Hold
- Amp: Up to 20A AC/DC
- Ohm: Up to 200 MΩ
- Freq: Up to 20MHz
- Capacitance: 1p - 200μF
- Logic: TTL
- TR hFE, Diode
- Continuity Beeper
- Double Insulated Jack
- Alligator Clip Test Leads
- Deluxe Holster w/Strap

Oscilloscope Probe Kit

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HP-9060, 60MHz
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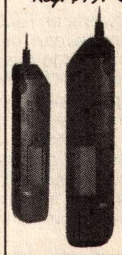
Reg. $49. **$24.00**

HP-9250, 250MHz
Reg. $59. **$32.00**

Pen-Type DMM w/Logic

Reg. $79. **$59.00**

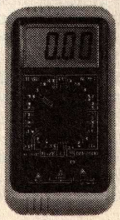


DM150

- 3 1/2 Digit
- Dual Display
- Auto & Manual
- DCV, ACV, ACA, DCA, Ω
- Logic CMOS/TTL
- Data Hold
- Diode
- Continuity

DMM w/Holster

Reg. $59. **$39.00**



DM2500

- 3 1/2 Digit
- 1.5" Big LCD
- 10A AC/DC AC/DC V, Ω
- Signal Injector
- Diode
- Continuity
- Holster

Multifunction DMM

Reg. $89. **$59.00**

DM3050

- 3 1/2 Digit
- 1.5" Big LCD
- Heavy Duty, 20A AC/DC
- Capacitance
- Frequency
- TR-hFE
- Diode
- Continuity
- Holster

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G5907 3/$1.00

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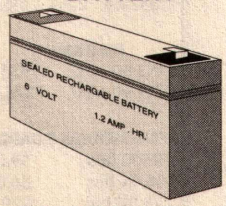
Same type found in copiers, hairdryers, toasters etc. These handle great amounts of current, however, when their temperature rating is exceeded they "blow out" permanently for fail safe operation. This one is made by Microtemp. Rated 167°C (333°F). Brand new-prime.

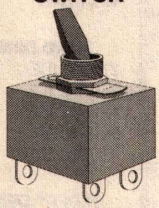
POWERSONIC 6V RECHARGABLE BATTERY



G5908 $7.95

Model PS-612 rated 6V at 1.2 amp Hr.Brand New. Size: 3 3/4"L x 7/8"W x 2"T.

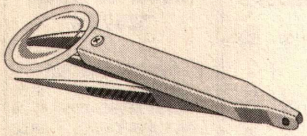
BREAKER TOGGLE SWITCH



G5909 $2.00

Brand new airpax circuit breaker is also a toggle switch. Breaker operates at 1/2 amp. Two SPST contacts. Size: 1 5/16" x 1 5/16". With all panel mtg. hardware. Airpax # 2-.500A-9236-3

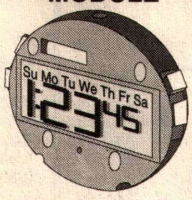
SMD TWEEZER/MAGNIFIER



G5910 $3.75

This is one of the most useful items for working with SMD parts.Tweezer foldes out from magnifying glass so that you can get a clear view of the tiny part you're picking up. Size: about 3 1/2" long. New in pouch.

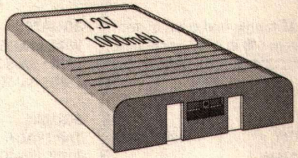
DIGITAL CLOCK MODULE



G5911 79¢ ea.

Displays day of week, date & time. Brand new but battery is dead from storage.

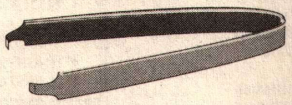
7.2V 1000MAH NICAD PACK



G5912 $8.95

Powerful, compact battery pack is brand new. Rated 7.2V 1,000mah. Size: 3 1/2" x 2" x 3/4". Looks like it was made for a camcorder.

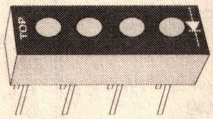
IC EXTRACTION TOOL



G5913 $1.25

Very useful IC extraction tool pulls all IC's out of socket without bending the pins. New from OK Industries.

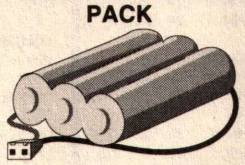
4 DIGIT LED BAR



G5914 4/$1.00

Bright red 4 digit LED bar is 1 9/16"L x 7/16"W. These have been stored in bulk so they may have a few scratches on case (not the LEDS) and tarnished leads. **Blowout price!**

3.6V 600MAH NICAD PACK

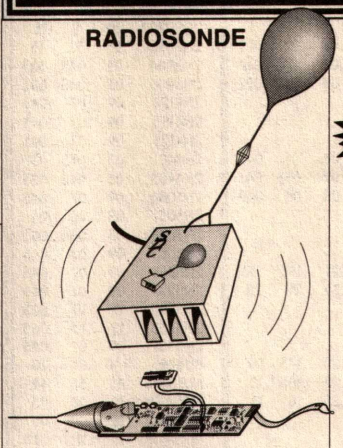


G5915 $3.50

Brand new nicad pack designed for phones. Consists of 3 AA size cells in series.

IF YOU CAN'T FIND WHAT YOU ARE LOOKING FOR, CALL FOR A FREE COPY OF OUR LATEST CATALOG. THIS CATALOG CONTAINS OUR ENTIRE PRODUCT LINE OF OVER 3,000 ITEMS AND IT IS STILL GROWING!

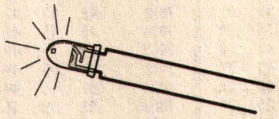
RADIOSONDE



G5058 $8.95

Very late model Radiosonde made for tracking all types of weather data. These were to be sent aloft attached to a weather balloon (not included). Each is about 10 1/2" long x 3 3/8" thick x 8" wide. Inside of the removable cardboard sleeve is a styrofoam chamber housing a sophisticated 8 IC circuit board which has sensors attached to measure atmospheric pressure, temperature and humidity. As it gathers the information, it transmits the data at about 1.677 gigahertz (GHZ). These are prime, brand new units that were waiting shipment from the manufacturer (Space Data Corporation) to the government when the contract ended. These are complete except for the 24V battery (we connected two 9V batteries in series and the unit worked perfectly from them). Sorry, no schematic available. These cost the government a bundle to have made but we are selling them at a giveaway price. Hurry, get your Radiosonde today!

BLUE T1 3/4 JUMBO LED

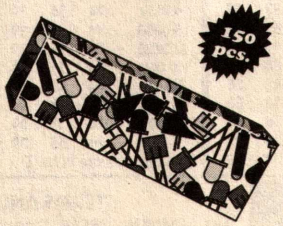


G5067 79¢

10/$7.50 • 100/$69.00

Factory fresh T1 3/4 Blue LED features clear lens and long leads. We purchased these directly from the factory and are offering them to you at close to our cost to provide you with a new dimension for your projects. The blue LED is made from silicon carbide and can withstand up to 50mA current without damage. We have found that it looks best if operated close to a 4VDC limit. Very unique and colorful!

BOX OF LEDS



G2502 $6.00

Various colors, sizes and shapes. About 150 pieces in a clear reclosable box.

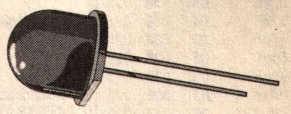
10" THRUSTER WOOFER

G3311 $12.95 EA.

PAIR FOR $25.00 (INCLUDE $5.00 S&H)

You will be amazed at the great sound of this high quality 10" woofer that is perfect for upgrading your old system or new construction. We were told these were made by JBL (their model #210H). They feature 8 ohm impedance, poly foam surround and a frequency response from 25HZ to 2KHZ. Weight: 2.5 lbs. Brand new and at an incredible blowout price!!!

GIANT RED LED

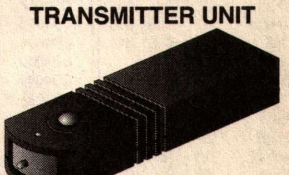


G5906 89¢ EA.

10 for $7.50

Incredibly large red LED features a bright red output that can be seen from a wide viewing angle. Size is 10mm with a diffused red case. Brand new, made by Sharp.

SUPER POWER MINIATURE IR TRANSMITTER UNIT

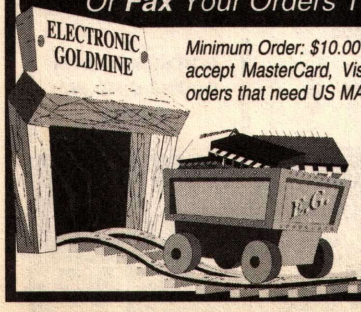


G5535 $1.69

2/$3.00 • 12/$15.00 • 120/$140.00

Make all kinds of I R remote activated projects with this transmitter and an I R receiver module. These were originally designed to activate a burglar alarm system (which we don't have) by remote control. The transmitter features a red activation button, a dip switch inside to change output code, operation from 9V battery (not included), red LED transmit indicator to show when IR energy is being transmitted and a compact 4 1/4" x 1 3/16" x 3/4" black stylish case. Brand new in blister pack with 2 peel and stick "premise protected" stickers. We also supply an info sheet that shows how to convert this transmitter unit into a programmable IR receiver so a pair of these transmitter units could cover both transmit and receive functions.

*For **Phone** Orders Call (602) 451-7454*
*Or **Fax** Your Orders To (602) 451-9495*



Minimum Order: $10.00 plus $4.00 Shipping and Handling. We accept MasterCard, Visa and Money orders. Canadians and orders that need US MAIL send minimum $5.00 S&H.

ELECTRONIC GOLDMINE
PO. Box 5408
Scottsdale, AZ 85261

CIRCLE 241 ON FREE INFORMATION CARD

ACCORD ELECTRONIC SYSTEMS, INC.

CAPACITORS

QTY	1	100	1000
RAD. LYTIC 25VDC			
1µF	.05	.040	.035
2.2µF	.05	.040	.035
3.3µF	.05	.040	.035
4.7µF	.05	.040	.035
6.8µF	.05	.040	.035
10µF	.05	.045	.04
22µF	.05	.045	.04
33µF	.06	.055	.05
47µF	.06	.055	.05
100µF	.08	.07	.05
220µF	.08	.07	.055
330µF	.09	.08	.06
470µF	.10	.09	.08
1000µF	.22	.20	.17
2200µF	.42	.40	.38
3300µF	.53	.50	.47
4700µF	.91	.87	.83
RAD. MONO 50V			
.001µF	.05	.045	.035
.0022µF	.05	.045	.035
.0047µF	.05	.045	.035
.01µF	.05	.045	.035
.022µF	.05	.045	.035
.047µF	.05	.045	.035
.1µF	.05	.045	.035
.22µF	.25	.22	.18
.47µF	.42	.35	.28
CERAMIC 50V			
5pF	.05	.038	.025
10pF	.05	.038	.025
18pF	.05	.038	.025
22pF	.05	.035	.025
27pF	.05	.038	.025
33pF	.05	.038	.025
47pF	.05	.038	.025
68pF	.05	.038	.025
82pF	.05	.038	.025
100pF	.05	.038	.025
120pF	.05	.038	.025
150pF	.05	.038	.025
180pF	.05	.038	.025
220pF	.05	.038	.025
270pF	.05	.038	.025
330pF	.05	.038	.025
470pF	.05	.038	.025
1000pF	.05	.038	.025
2200pF	.05	.038	.025
3300pF	.05	.038	.025
4700pF	.05	.038	.025
.01µF	.05	.038	.025
.022µF	.05	.04	.03
.047µF	.07	.055	.035
.1µF	.07	.058	.04
DIP TANT. 25VDC			
1µF	.14	.11	.08
2.2µF	.14	.11	.08
4.7µF	.23	.185	.14
10µF	.28	.26	.22
22µF	.34	.27	.24
47µF	1.22	1.07	.94
AXIAL LYTIC 25VDC			
4.7µF	.09	.075	.054
10µF	.10	.08	.06
22µF	.14	.115	.084
47µF	.16	.13	.096
100µF	.19	.15	.11
220µF	.27	.215	.16
470µF	.35	.28	.31
1000µF	.45	.36	.27
2200µF	.89	.715	.54

DIODES

QTY	1	100	1000
1 AMP RECTIFIER			
1N4001	.03	.02	.015
1N4004	.04	.025	.019
1N4007	.05	.035	.022
3 AMP RECTIFIER			
1N5401	.06	.05	.042
1N5404	.07	.055	.045
1N5408	.08	.06	.049
6 AMP RECTIFIER			
6A10	.21	.185	.156
6A100	.32	.29	.25
1 AMP SCHOTTKY			
1N5817	.20	.145	.09
1N5818	.23	.165	.10
1N5819	.25	.18	.11
3 AMP SCHOTTKY			
1N5820	.34	.255	.17
1N5821	.38	.285	.19
1N5822	.42	.315	.21
GERMANIUM			
1N34A	.10	.08	.06
1N60	.10	.08	.06
1N270	.17	.15	.13
SWITCHING			
1N914	.035	.025	.015
1N4148	.025	.02	.01
1N4448	.035	.025	.015
1 W ZENER			
1N4728 through 1N4764	.06	.054	.047

INTEGRATED CIRCUITS

QTY	1	100	1000
PART #			
TIL111	.38	.34	.31
MC1458	.43	.36	.29
LM1488	.47	.43	.39
LM1489	.47	.43	.39
CD4001	.29	.25	.21
CD4011	.29	.25	.21
CD4013	.37	.33	.29
CD4017	.37	.33	.29
CD4025	.37	.33	.29
CD4028	.37	.33	.29
CD4040	.47	.43	.39
CD4049	.37	.33	.29
CD4051	.44	.40	.36
CD4066	.38	.34	.31
CD4069	.37	.33	.29
CD4093	.37	.33	.29
MOC3011	.40	.36	.32
LM311	.37	.33	.29
LM324	.47	.36	.25
LM339	.48	.37	.27
LM358	.48	.37	.27
LM386	.67	.49	.33
LM393	.37	.33	.29
4N25	.54	.39	.28
4N28	.58	.41	.34
LM555	.43	.38	.33
LM556	.47	.42	.38
LM741	.43	.38	.33
74LS244	.40	.36	.32
74LS245	.37	.33	.29
74LS374	.37	.33	.29

TRANSISTORS

QTY	1	100	1000
PART #			
2N2222A	.20	.18	.15
2N3055	.55	.50	.45
2N3904	.05	.045	.035
2N3906	.05	.045	.035
2N4124	.09	.07	.045
2N4125	.09	.07	.045
2N4126	.09	.07	.045
2N4401	.05	.045	.035
2N4403	.05	.045	.035
2N5086	.09	.07	.045
2N5087	.08	.06	.04
2N5088	.08	.06	.04
2N5089	.09	.07	.045
2N5209	.09	.07	.045
2N5210	.09	.07	.045
2N5400	.12	.10	.065
2N5550	.12	.10	.065
2N5551	.09	.07	.045
BU806	1.10	.80	.70
MJE3055T	.65	.55	.44
MPSA-05	.10	.08	.05
MPSA-10	.12	.09	.06
MPSA-13	.15	.11	.075
MPSA-14	.15	.11	.075
MPSA-42	.14	.105	.07
MPSA-44	.22	.18	.12
MPSA-56	.10	.08	.05
MPSA-63	.45	.34	.22
MPSA-92	.12	.09	.06
MPSA-93	.15	.11	.075
MPSH-10	.12	.09	.06
MPSH-81	.44	.33	.21
PN2222A	.05	.045	.035
PN2907A	.05	.045	.035
TIP30	.42	.37	.32
TIP31	.42	.37	.32
TIP41	.49	.44	.39
TIP112	.56	.51	.46
TIP122	.57	.52	.47
TIP125	.53	.48	.43
TIP126	.56	.51	.46

VOLTAGE REGULATORS

QTY	1	100	1000
PART #			
7805	.48	.45	.42
7812	.48	.45	.42
7824	.48	.45	.42
7905	.61	.55	.49
7912	.61	.55	.49
7924	.61	.55	.49
78L05	.35	.31	.26
78L12	.35	.31	.26
79L05	.35	.31	.26
79L12	.35	.31	.26
LM317T	.95	.82	.68
LM350T	2.05	1.70	1.35

CRYSTALS

QTY	1	100	1000
HC18 case			
1.8432	.89	.67	.45
2.0000	.74	.55	.39
3.5795	.74	.55	.39
3.6864	.74	.55	.39
4.0000	.74	.55	.39
4.9152	.74	.55	.39
5.0688	.74	.55	.39
7.3728	.74	.55	.39
10.000	.74	.55	.39
11.000	.74	.55	.39
11.059	.74	.55	.39
12.000	.74	.55	.39
14.3181	.74	.55	.39

frequencies are in MHZ

SWITCHES

QTY	1	100	1000
DIP STYLE			
4 POS.	.68	.58	.48
6 POS.	.77	.67	.57
8 POS.	.80	.70	.60
10 POS.	.95	.85	.75
TOGGLE			
SPDT	.62	.52	.40
SPDT-off	.73	.63	.49
DPDT	.69	.59	.46
DPDT-off	.86	.76	.59
PUSH BUTTON			
N. open	.28	.24	.20
N. closed	.29	.25	.21

All toggle and push button switches fit in a ¼" panel hole

LED's

QTY	1	100	1000
3MM			
RED	.06	.05	.04
GREEN	.07	.06	.045
YELLOW	.08	.07	.05
5MM			
RED	.06	.05	.04
GREEN	.07	.06	.045
YELLOW	.08	.07	.05
BI-COLOR	.29	.22	.17
BLUE	1.20	1.10	.95
BLINKER			
RED 5mm	.65	.53	.41
HOLDERS			
3mm	.10	.07	.055
5mm	.10	.07	.055

IC SOCKETS

QTY	1	100	1000
REGULAR			
8 PIN	.04	.035	.025
14 PIN	.08	.063	.045
16 PIN	.10	.08	.055
18 PIN	.11	.085	.06
20 PIN	.12	.095	.07
24 PIN	.15	.115	.08
28 PIN	.17	.13	.09
32 PIN	.20	.155	.11
40 PIN	.24	.185	.13
MACHINE			
8 PIN	.16	.135	.11
14 PIN	.28	.24	.185
16 PIN	.32	.27	.21
18 PIN	.36	.30	.235
20 PIN	.40	.33	.26
24 PIN	.48	.40	.32
28 PIN	.56	.47	.37
32 PIN	.64	.53	.42
40 PIN	.80	.66	.52
WIRE WRAP			
8 PIN	.32	.29	.26
14 PIN	.56	.51	.46
16 PIN	.64	.58	.52
18 PIN	.72	.66	.59
20 PIN	.80	.73	.65
24 PIN	.96	.87	.78
28 PIN	1.12	1.02	.91
32 PIN	1.28	1.16	1.04
40 PIN	1.60	1.45	1.30

BRIDGE RECTIFIER

QTY	1	100
IN LINE		
RS101 1A-50V	.60	.33
RS106 1A-800V	.93	.52
3N256 2A-400V	.95	.53
TL400 4A-50V	.65	.37
TU600 6A-50V	1.02	.65
TU800 8A-50V	1.33	.75
8 PIN DIP		
DF005M 1A-50V	.25	.18
DF10M 1A-1KV	.52	.33
ROUND		
W04M 1A-400V	.35	.17
2W10M 2A-1KV	.50	.27
SQUARE WIRE LEADS		
TB305 3A-50V	.53	.30
TB805 8A-50V	.93	.52
SQUARE TAB LEADS		
TB151 15A-100V	2.30	1.35
TB352 35A-200V	2.68	1.50

special pricing available for quantity over 500pcs.

CABLE TIES

NATURAL COLOR

QTY	100	1000	5000
4" LENGHT	2.00	7.00	30.00
8" LENGHT	4.00	25.00	98.00

1Lb SOLDER ROLL

.031" diameter

SN60/40

$6.50 each

RESISTORS

ANY STANDARD VALUE

QTY	50	1000	5000
¼ W 5%	.80	7.00	28.00

These are prices for total quantity of same value. No mixing.

D-SUB CONNECTORS

QTY	1	100	1000
SOLDER CUP			
DB9 m.	.29	.22	.15
DB9 f.	.29	.22	.15
DB15 m.	.35	.27	.19
DB15 f.	.37	.29	.21
DB25 m.	.53	.37	.21
DB25 f.	.57	.42	.26
RIGHT ANGLE			
DB-9 m.	.49	.39	.30
DB-9 f.	.49	.39	.30
DB15 m.	.54	.44	.33
DB15 f.	.54	.44	.33
DB-25 m.	.69	.54	.49
DB-25 f.	.69	.54	.39
PLASTIC HOOD FOR DB			
DB-09	.26	.195	.13
DB-15	.29	.24	.19
DB-25	.31	.26	.21
DB-37	.53	.43	.34

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NEW PRICES

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SLC2-66		260.00
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DX2-50	128K	351.00
DX2-66	256K	416.00

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PCI 90 MHZ	1,375.00

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VESA 2MB	195.00

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540 MB SCSI	488.00

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1.44MB	3½"	32.00
1.2MB	5¼"	53.00
3½" + 5¼"		122.00

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1024 X 768 .28mm

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ISA SCSI CARD	72.00

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FULL TOWER	130.00

with display and 200w p/s

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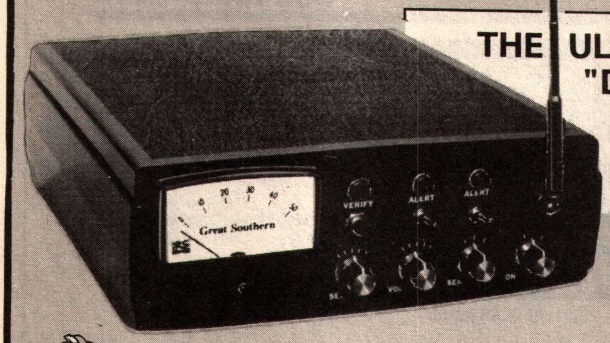
CIRCLE 211 ON FREE INFORMATION CARD

ARE YOU BEING "BUGGED?"

EVEN AS YOU READ THIS, countless individuals and firms are being enormously damaged by having their private conversations overheard, monitored, and\or recorded.

Almost without exception and AFTER the fact, the victims make a statement something along the lines of "But, I never thought it would happen to ME!"

OUR FINEST Counter-Surveillance Device



THE ULTIMATE IN "BUG" DETECTION EQUIPMENT "DEBUGS" ROOMS AND TELEPHONES!

If you require GUARANTEED PROTECTION against electronic telephone monitoring devices and also require COMPLETE CONFIDENTIAL PRIVACY in certain rooms and areas, we highly recommend the COUNTER-SURVEILLANCE DETECTOR CSD-18.

CONDUCT A PROFESSIONAL SEARCH... ANYTIME...ANYWHERE!

Every newspaper and magazine article and every radio and TV story discussing some new episode involving "Bugging" devices, continues to increase the ever growing demand for electronic Counter-Surveillance "sweeps" and equipment. The very limited supply of competently trained and equipped Counter-Surveillance specialists has created a situation where "sweep" rates exceeding $250 per hour are now considered reasonable and appropriate.

This is an exciting, immensely interesting and profitable field that you can enter with a minimum investment. Two hours actual practice with the CSD-18 will have you "reading" and "clearing" telephones and rooms with professional ease and competence. The average fee for "debugging" a single telephone is over $200.00. It requires about 45 minutes to complete the job and once it gets around that YOU can provide this service, you'll quickly have more clients than you can handle. Even if you choose to provide "sweeps" for only a small number of friends and associates, your initial investment will quickly be returned many times over.

EXTREME SENSITIVITY!

This is our finest piece of detection equipment! The CSD-18 quickly locates electronic eavesdropping devices in telephones, homes, offices, vehicles, boats, or concealed on the body. It will actually pick up many eavesdropping transmitters at ranges exceeding 25 feet! Extreme sensitivity is obtained via ultra-efficent amplification circuitry following the RF detection stages. Excellent quality Dynamic Headphones exclude all external sounds to further enhance detector output.

The presence of any "bug" is immediately indicated via a pronounced meter deflection. The CSD-18 quickly "homes-in" on eavesdropping transmitters and immediately pinpoints their location. The closer you get to the "bug", the further the needle moves to the right. It's as simple as that.

FULL RANGE DYNAMIC HEADPHONES

"FLASHING" LED WARNS YOU INSTANTLY!

And, for maximum telephone security, the CSD-18 automatically analyzes a sophisticated series of electronic measurements along the telephone line and converts the analysis into an easy to follow, step by step, test procedure. No technical knowledge is required or necessary. A visual indication (via a flashing LED) immediately reveals the presence of the various types of telephone "taps" and the flashing sequence identifies the actual type of eavesdropping device.

MAXIMUM SECURITY — EASY OPERATION!

Latest Computer-Age IC circuitry designed exclusively for maximum security and ease of operation, assures the utmost privacy protection possible today against virtually all types of room "bugs" and telephone "taps". The CSD-18 detects even the very latest ultra-sophisticated devices specifically designed to defeat detection via polarity negating circuitry. Also includes multi-line option for testing business telephones.

FREE BONUS!

FASCINATING HI-TECH INFORMATION PACKAGE INCLUDED FREE!

LATEST EAVESDROPPING DEVELOPMENTS

A detailed analysis of a variety of extremely fascinating hi-tech devices and procedures used for ultra-sophisticated audio and video eavesdropping including infrared monitoring, multi-data eavesdropping and interception, miniature micro-wave devices, new methods for listening thru walls, etc., with many schematics included. You'll learn about electronic voice changers, corporate spying, how data banks are accessed to research anyone and anything, eavesdropping by neighbors; space age personnel and vehicle tracking systems, how missing persons are found, how lie detectors are deceived, and a fact-filled section on Eavesdropping Law.

BIG MONEY IN COUNTER-SURVEILLANCE

Complete information describing the fantastic opportunities that are now open to trained Counter-Surveillance technicians and exactly how a number of individuals and firms are reaping a huge bonanza in the booming "Debugging" business! You'll learn how the ever increasing use of Electronic Listening Devices by investigative agencies, government agencies, unscrupulous business competitors, jealous suitors, etc., has created a tremendous demand for this type of service.

A comprehensive information package JAM-PACKED FULL of some of the most exciting and fascinating reading imaginable. Reads like a James Bond novel, with one important exception...IT'S NOT FICTION!

THE ONE "BUG" TO FEAR MOST!

While most individuals are now somewhat guarded in their telephone conversations, they still rather naively feel secure in the "privacy" of their own home or office. However, the most common type of tap presently used by eavesdroppers picks up ALL SOUNDS AND CONVERSATION WITHIN A ROOM....WITH THE TELEPHONE STILL ON THE HOOK!

Due to this devastating capability, this "Infinity" tap (variously referred to as Infinity Transmitter, Hookswitch Bypass, 3rd Wire, Harmonica Bug, etc.), has become the "bug of choice".

In flagrant violation of federal law prohibiting their use and sale, these devices in various forms are openly advertised in many technical publications for as little as $75. Literally thousands of these devices are now in the hands of unscrupulous individuals all over the country!

In response to this ever-growing threat, a uniquely engineered feature of the CSD-18 now also detects Infinity type devices anywhere "down the line".

In other words, if anyone ... ANYWHERE ... is utilizing the telephone tip and/or ring wires to monitor your private room conversations while your telephone is on the hook, you'll immediately be made aware of it via a flashing LED!

100% POSITIVE INDICATION

The CSD-18 also flawlessly detects "Series" and "Parallel" telephone transmitters and "Telephone Recording Devices". And, a separate feature silently indicates when extension phones are picked up or being used. The CSD-18 completely eliminates all doubt and guesswork.

EXCLUSIVE "LISTEN-IN" FEATURE!

The CSD-18 will even allow you to "listen-in" to exactly what the eavesdropper is monitoring. And, without the eavesdropper ever becoming aware that he has been detected! We are unaware of ANY other detection equipment having this combined capability AT ANY PRICE!

MAXIMUM PROTECTION

The CSD-18 provides maximum protection against ALL major catagories of surveillance equipment including:

- ALL TYPES OF "CONCEALED TRANSMITTERS"
- "BUMPER BEEPERS"
- "INFINITY" DEVICES
- "BODY" TRANSMITTERS
- "TELEPHONE RECORDING DEVICES"
- "SERIES" & "PARALLEL" PHONE TRANSMITTERS

CSD-18 $295 Complete

Including batteries, antenna/probe, headphones, all plugs & adapters, extensive information package and instructions.

HOW TO ORDER

Order NOW by Mail or Telephone. 10 DAY MONEY BACK GUARANTEE if you're not 100% pleased and completely satisfied. We pay shipping charges on all prepaid & credit card orders. Add $15 for CODs.

(c) 1992 **Great Southern Security**
513 Bankhead Highway (SF)
Carrolton, Georgia 30117

FOR FASTEST SERVICE CALL TOLL FREE

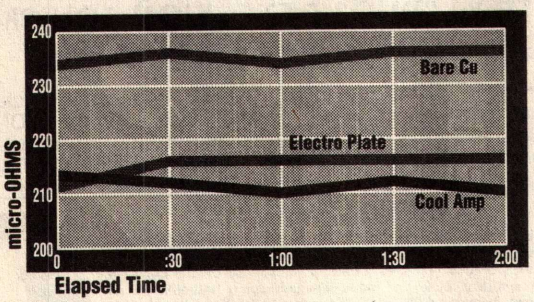
ORDER BY PHONE 1 800 732-5000

VISA MasterCard DISCOVER

In recent independent tests Cool-Amp is proven better than electroplating.

(For 50 years we've said Cool-Amp is "equal to" electroplating in performance. It is better.)

Cool-Amp

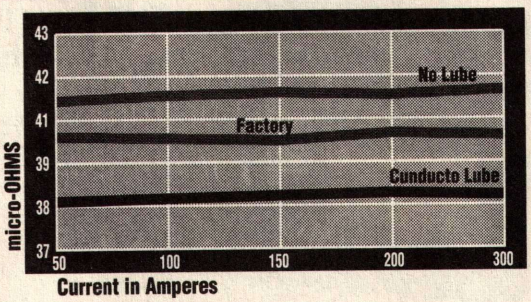


From the report:

"...compare the conducting properties of Cool-Amp silver plating compound with factory silver elctro-plated bus and bare copper bus.

"The test results indicated that the contact resistance of the Cool-Amp plated bus connection was slightly lower than that of the electro-plated bus connection and much lower than that of the bare copper bus connection. The final temperature at temperature equilibrium of the bus connection employing Cool-Amp was slightly lower than that of the electro-plated bus connection and the bare copper bus connection..."

Conducto-Lube



From the report:

"...compare the conducting properties of Conducto-Lube lubricant with factory lubrication and non-lubricated connections on an air switch. Identical test setups and procedures were used for each test so that comparative data could be collected and the relative performance of each type of connection could be quantified.

"The test results indicated that the contact resistance of the switch employing Conducto-Lube was generally lower than that of the factory lubricated switch and the switch that used no lubricant."

Cool-Amp How it works:

- Applies *on the job.* Application is simple. Yet Cool-Amp adheres permanently. As tests show, it is better than electroplating.
- Minimizes overheating and power loss by silver plating high amperage connections.
- Saves time, reduces maintenance. Cool-Amp is so simple to apply on the job. It assures maximum conductivity for copper, brass, or bronze contacts and prevents losses due to oxidation.

A one-pound bottle of Cool-Amp silver plating powder plates approximately 6,000 square inches.

Conductivity is demonstrated by inserting test prongs into a container of Conducto-Lube and establishing a circuit. Photo shows low voltage (115 VAC) continuity through container.

Conducto-Lube How it works:

- This is *the* conductive lubricant; highly conductive because it contains pure silver.
- Originally developed to lubricate switches, to the point tension can be adjusted to factory specs allowing full rated capacity of the switch to be maintained at all times.
- Uses have continued to expland–from switches and breakers–to any application where a conductive lubricant is needed.

*Various tests were performed on both products in the Electro-Test, Inc. facilities in Portland, Oregon during January-March, 1994. Evaluation of plating thickness of Cool-Amp was performed by Surface Science Laboratories of Mountain View, California.

COOL-AMP

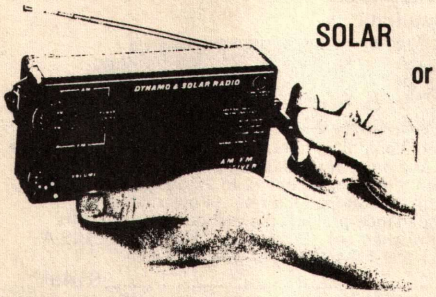
Conducto-Lube

Cool-Amp Conducto-Lube Company
15834 Upper Boones Ferry Road
Lake Oswego, Oregon 97035
Order factory direct:
503/624-6426, Fax 503/624-6436

CIRCLE 228 ON FREE INFORMATION CARD

SOLAR TECHNOLOGY

SOLAR/DYNAMO RADIO - ORDER #836 $35



SOLAR
or
DYNAMO
or
BATTERY
POWERED

USE FOR EMERGENCIES, OUTDOORS, FUN

Sunlight powers AM/FM radio outdoors for indefinite playtime during daytime. The sun's stored energy powers the radio at night. Two AA batteries can be installed for additional backup power. If all power sources are unavailable, a built-in hand crank generator can be used to charge an internal rechargeable battery. 2 minutes of hand crank supplies approximately 20 minutes of radio playtime.

SOLAR VISOR RADIO - ORDER #830 $27

SPECIFY COLOR

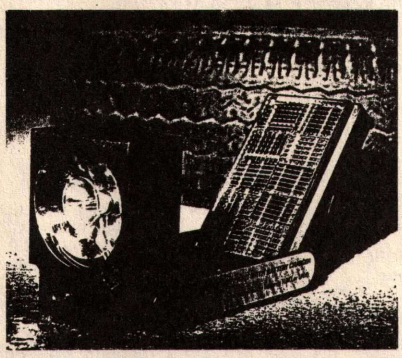
YELLOW

RED

FOR SPORTING EVENTS, BEACH, SAILING, BIKING

This AM/FM solar visor radio uses free energy from the sun. Once fully charged in sunlight or incandescent light, the Visor can play for up to 8 hours. Swivel allows radio speaker to swing into place. Adjustable headband fits all sizes.

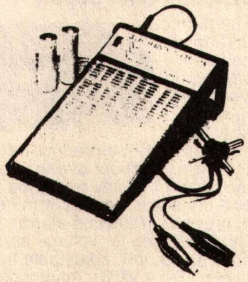
SOLAR EMERGENCY LIGHT - Order #628 $20



The sun charges the built-in circuit for use at night. 2 supplied AA rechargeable batteries included as backup power or to charge and use in other appliances. Sockets for AA and AAA available for this purpose. Switch setting for strobe or steady light, and amber or white light.

ROADSIDE EMERGENCIES, BATTERY CHARGER

3,6,9 VOLT SOLAR PANEL - ORDER #838 $20



Uses sun's energy to power your standard radios and other appliances. Comes with omni plug and alligator clips for connection to most products. This unit also charges your AA rechargeable batteries. It comes with two AA rechargeable batteries. Solar Panel provides 100 MA at 3V or 50 MA at 6V and 9V. Do your own solar experiments.

FOR CAMPING, EMERGENCY KITS, EXPERIMENTS

SOLAR WATCH - ORDER #218 $16

Specify Color
RED OR BLACK

FOR INDOOR OR OUTDOOR USE

Short exposure to sun powers watch for many days and months. Indoor light sustains charge for year round use. Hour, minute, second, month, day. Water resistent.

IMMEDIATE AVAILABILITY

24 HR ORDER DESK: 408-354-5580 MC/VISA ACCEPTED

1. List order # of items desired
2. List quantity & price
3. Add total extended price
4. Add **$4** shipping and handling
5. **CA** residents add **8.25%** of 3.

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P.O. BOX 35695 (DEPT E)

MONTE SERENO, CA 95030-0695

CIRCLE 324 ON FREE INFORMATION CARD

Parts Express International Inc.

1" Titanium Dome Tweeter

Features a ferro fluid cooled Kapton voice coil and a rubber surround. Very natural sounding high frequency reproduction with extended response to 30KHz. •Power handling: 50 watts RMS/75 watts max •Voice coil diameter: 1" •Impedance: 8 ohms •Frequency response: 2500-30,000 Hz •Magnet weight: 5.3 oz. •Fs: 1000 Hz •SPL: 93 dB 1W/1m •Net weight: 1 lb.

#EN-275-050 .. $17.50 (1-3) ... $15.80 (4-UP)

10" Treated Paper Cone Woofer

This 10" woofer features a non-pressed, polymer laminate cone and a rubber surround. Well suited for applications where a high level of performance is desired, but at a reasonable price. Aluminum voice coil and vented pole piece. •Power handling: 70 watts RMS/105 watts max •Voice coil diameter: 1-1/2" •Impedance: 8 ohms •Frequency response: 30-2,800 Hz •Magnet weight: 20 oz. •Fs: 31 •SPL: 91 dB 1W/1m •Vas: 4.1 cu. ft. •Qts: .35 •Qes: .39 •Qms: 3.69 •Xmax: .27 in. •Net weight: 4 lbs.

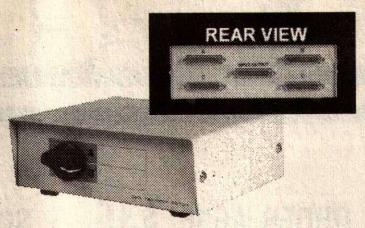
#EN-295-260 $29.80 (1-3) $26.90 (4-UP)

12" Musical Instrument Speaker

Ribbed paper cone with treated cloth accordion surround. Vented pole piece for heat dissipation and reduced distortion. Perfect replacement for many P.A. and musical type speakers. •Power handling: 150 watts RMS/200 watts max. •Voice coil diameter: 2 inches •Impedance: 8 ohms •Frequency response: 50-5000 •Magnet weight: 50 ozs. •Fs: 50 Hz •SPL: 96 dB 1W/1m •Vas: 3.56 •Qts: .43 •Qes: .49 •Qms: 3.62 •Xmax: .129 •Net weight: 10 lbs. •Manufacturer model number: A30GC50-52FQ.

#EN-290-142 .. $49.80 (1-3) ... $45.50 (4-UP)

RS-232 A-B Switch



Fully shielded, steel enclosed data switch with gold plated female connectors. All 25 pins switched through. High reliability rotary type switch. Compact size. Anti-skid rubber feet. Boxed. Can be used to switch multiple printers or computers. 1 year guarantee. Net weight: 1-3/4 lbs.

#EN-130-010 ..... $10.50 (1-2) $9.95 (3-UP)

High Voltage Capacitor Kit

This 85 piece kit contains a selection of 250, 350, and 450 volt electrolytic capacitors. 5 pieces each of 1, 2.2, 3.3, 4.7, 6.8, 10, 22uf and 2 pieces each of 33, and 47uf, 250V radial caps. 5 pieces each of 1, 2.2, 3.3, 4.7, 10uf and 2 pieces each of 22, 33uf, 350V radial caps. 5 pieces each of 1, 2.2, 4.7uf and 2 pieces of 10uf, 450V radial caps. Over $62.00 wholesale cost if purchased individually. Net weight: 1 lb.

#EN-020-950 ..... $49.95 EACH

22 Amp Power Supply

The perfect test bench power supply. You can run just about any 12 VDC powered product without worrying about overloading the supply. Highly regulated IC and transistor circuitry with built in crowbar protection alarm. Dual metering for voltage and current. Output adjustable between 10-14 VDC. Adjustable output current for testing amplifiers. 2 year warranty.

Specifications:

- Output voltage ..... 10-14 VDC
- Output current (cont) 22 amps
- Output current (surge) 25 amps
- Dimensions ..... 9"x5"x11"
- Net weight ..... 19 lbs

#EN-120-504 $139.95 (1-3) $129.90 (4-UP)

Strobe Flasher

Weatherproof red strobe flasher. Includes 9/16" mounting stud and foam gasket. Operating range 6-12 VDC. 2-3/4" (W) x 1-5/8" (dia). Net weight: 1/4 lb.

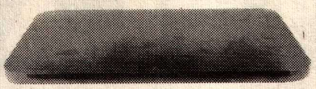
#EN-335-123 .. $12.50 (1-3) ... $11.25 (4-UP)

3M Super 77 Spray Adhesive

A high tack, fast drying transparent adhesive to permanently attach carpeting, cloth, foils, foams, etc. to wood, metal, painted or unpainted surfaces. High initial "grab" with sufficient time to position materials. 24 oz. can with two spray head actuators (wide and round).

#EN-340-255 ..... $9.95 (1-11) ..... $7.95 (12-35) $7.50 (36-UP)

Technicians' Turntable



Turntable to speed repair of VCRs, TVs and more. Allows technician to easily turn unit for convenient repair. Dimensions: 20" W x 15" D x 1-1/8" H. Black pebbled surface. Includes 4 anti-skid adhesive feet. Net weight: 9 lbs.

#EN-360-427 ..... $28.50 EACH

Multi-Speaker Distribution Box

This multi-speaker distribution box features metal construction, inputs for left and right channels, and 8 set of speaker outputs. Color coded, spring loaded pushbutton terminals accept 12 to 22 gauge wire. Built in impedance protection can be switched in or out. Power handling capacity: 300 watts (impedance protection switched off), 150 watts (impedance protection switched on). Black color. Made in the U.S A. Dimensions: 19"W x 3-1/2"H x 2-1/4"D. Net weight: 2 lbs.

#EN-300-600 ..... $149.80 EACH

Center Off Toggle

DPDT center off toggle switch. 6A, 125VAC. (1/2" mount.)

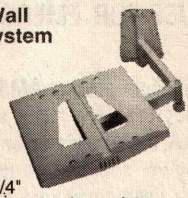
#EN-060-087 . $1.75 (1-9) . $1.50 (10-UP)

F-59 Deluxe Connector

Popular connector for cable TV systems. Full attached ferrule for hex crimp. Securely holds RG-59 cable.

#EN-090-355 .. 29¢ (1-49) ..... 22¢ (50-UP)

Deluxe TV Wall Mounting System

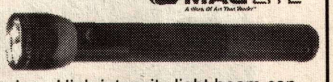


Deluxe wall bracket features heavy duty, all steel construction and the platform is adjustable from 12-1/4" to 16-3/4". Has 4 pivoting points and swivels 180 degrees for a variety of viewing angles. 60 lb. capacity. White enamel finish. Must be mounted directly to studs. Net weight: 9 lbs.

#EN-240-772 .. $36.50 (1-3) ... $32.80 (4-UP)

Mag-Lite Focusable Flashlight

MAG-LITE



These high tech flashlight from Mag-Lite are constructed of rugged aircraft aluminum for shock resistance and are anodized inside and out to guard against corrosion. High intensity light beam can be easily focused from a flood to a spot. Rubber "O" rings provide excellent moisture resistance. The sealed switch is self cleaning to eliminate oxidation and to ensure high reliability. Don't settle for imitations. See why most police and fire departments across the country use Mag-Lite! Includes spare krypton lamp. Lifetime manufacturer warranty. Designed and manufactured in the U.S.A.

Part #	Description	Price (1-3)	Price (4-9)	Price (10-UP)
EN-361-510	2 D-cell black	$22.90	$20.50	**$19.50**
EN-361-515	2 D-cell red	22.90	20.50	**19.50**
EN-361-520	3 D-cell black	23.90	21.45	**19.95**
EN-361-525	3 D-cell red	23.90	21.45	**19.95**
EN-361-530	5 D-cell black	25.95	23.50	**21.90**
EN-361-535	5 D-cell red	25.95	23.50	**21.90**
EN-361-540	Mini AAA cell black	11.50	9.95	**9.25**
EN-361-545	Mini AAA cell red	11.50	9.95	**9.25**
EN-361-550	Mini AAA cell blue	11.50	9.95	**9.25**
EN-361-555	D-cell wall mount brackets	5.20	4.70	**3.95**

Cabinet Carpet

This high quality carpet conforms easily to sharp corners because it has no stiff backing. You can also stretch it to cover irregular shapes. This is the covering of choice for car, stage, and amplifier cabinets. Carpet is strong, yet easy to cut with knife or scissors. Adhere with spray adhesive or latex contact cements. Provides protection and good looks. Sold by the linear yard. 54" wide.

#EN-260-765 Dark Charcoal
#EN-260-767 Medium Grey
#EN-260-768 Jet Black

Per Linear Yard, 36" x 54" ..... $4.50 (1-49 YDS) ..... $3.25 (50 YDS-UP)

Parts Express
340 East First St.
Dayton, Ohio 45402
Local: 513-222-0173
FAX: 513-222-4644

•30 day money back guarantee •$20.00 minimum order •We accept Mastercard, Visa, Discover, and company C.O.D. orders •24 hour shipping •Shipping charge = UPS chart rate + $1.50 ($4.00 minimum charge •Hours 8:30 am - 7:00 pm ET, Monday - Friday •9:00 am - 5:00 pm Saturday. Mail order customers, please call for shipping estimate on orders exceeding 5 lbs. •Foreign destination customers please send $6.00 U.S. funds for catalog.

CIRCLE 262 ON FREE INFORMATION CARD

Parts Express
International Inc.

Teac Floppy Disk Drives

High quality disk drives made by Teac. Standard putty color. High density 3-1/2", 1.44 MB and 5-1/4", 1.2 MB.

(3-1/2" drive)
#EN-130-530 .. $59.90 EACH . $55.80 (2-UP)

(5-1/4" drive)
#EN-130-532 .. $69.90 EACH . $64.95 (2-UP)

The Ultimate Test CD

The Ultimate Test CD was designed for use by both the audio amateur and the professional sound engineer. This CD can be used to test CD players, speakers, amplifiers, and for tuning instruments. The manual is written in easy to understand English and takes you step-by-step through each track of the CD and explains its purpose. The Ultimate Test CD is a necessary tool for anyone who is serious about quality audio sound.

#EN-510-100 ..... $7.95 EACH

Ungar UTC SS

The Ungar UTC SS is an economical dual wattage soldering station for use in the home, shop or at work. Dual temperature capability makes it ideal for surface mount components. Station includes an iron holder, and tip protects electronic components from static discharge. UL listed. Net weight: 2 lbs.

#EN-372-060 ..... $59.80 EACH

3 In 1 Universal Remote

This remote will operate any remote controlled cable box, TV or VCR at just a fraction of the cost of a factory replacement! This unit is already preprogrammed to include the most common codes. It is attractively styled, durable, and easy to set up and operate. The manufacturer even offers a toll free consumer help line to answer questions and provide customer assistance. Requires 2 AAA batteries (not included).

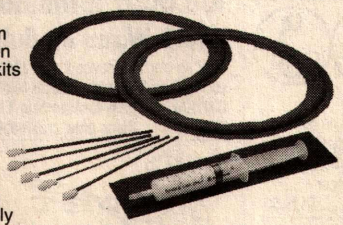
#EN-180-565 .. $12.50 (1-9) . $9.95 (10-UP)

Designing, Building, And Testing Your Own Speaker System

Completely revised and updated to reflect the latest trends in audio technology, this edition of David B. Weems' best-seller will guide do-it-yourselfers through the building and testing of low-cost speaker systems that rival the most expensive units on the market. 224 pages. Copyright: 1990. Third edition. Net weight: 1 lb.

#EN-500-021 ..... $16.95 EACH

Speaker Surround Repair Kits



Don't throw away expensive loudspeakers just because the foam surround has dry rotted, or has been punctured. With these new repair kits from Parts Express, you can save BIG bucks by repairing the foam surround and avoid costly loudspeaker replacements. The kit includes 2 pair foam surrounds (except for the 15" kit which includes one pair), a plastic syringe filled with 25cc of adhesive (specially formulated for various speaker cone materials), 5 foam swabs for application of glue, and complete repair instructions.

Part #	Size	Price (1-3)	Price (4-UP)
EN-260-920	8" kit	$19.95	$17.95
EN-260-925	10" kit	20.50	18.50
EN-260-930	12" kit	21.90	19.90
EN-260-935	15" kit	22.90	20.90

Head/Disc Cleaner

Head and Disc Cleaner is a CFC free cleaner which will remove carbon deposits, metallic oxides, dirt, dust and other contaminants from magnetic heads. Non-flammable Head and Disc Cleaner has superior cleaning properties compared to freon blends and is safe on most plastics. HCFC blend. 6 oz. liquid.

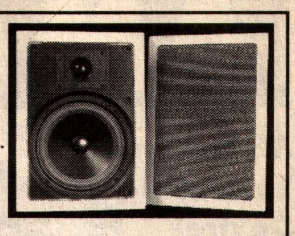
#EN-341-075 ..... $3.80 (1-11) ..... $3.40 (12-23) $3.25 (24-UP)

Drive Belt Kit

We've selected 18 of our most popular VCR, cassette and turntable belts to include in this kit. 87 belts total, five each of 17 square belts from 2.3" to 13.2" for VCRs and cassettes, and 2 each of the 23.6" turntable belt. Have the belt you need in stock when you need it. A $50.00 value. Net weight: 1/4 lb.

#EN-400-910 ..... $29.95 KIT

6-1/2" Two-Way System



The basis of all architectural audio systems. This is our most popular in-wall. The perfect system for main and/or surround speakers. Easily installed in any 2 x 4 or larger wall. Retrofit design allows installation in new or existing walls in minutes. Features high quality crossovers and premium drivers that can outperform the name brands.
Specifications: 6-1/2" poly woofer with a 10 oz. magnet, 1" field replaceable soft dome tweeter. Integral 2-way crossover with pushbutton wire terminal. 8 ohm impedance. Frequency response: 40-20,000 Hz. 40 watts RMS/80 watts max power handling capability. Sensitivity: 90 dB 1W/1m. Dimensions: 8-1/2" (W) x 12" (L) x 3-1/2" (D). Net weight: 9 lbs. per pair.

#EN-300-036 ..... $249.95 (SUG. LIST) ..... $124.90 (1-3 PRS) ..... $112.95 (4 PRS-UP)

Kester "44" Solder

Kester "44" rosin core solder is designed for electronic and electrical work. It uses a fast acting, instant wetting, non-corrosive, and non-conductive flux for faster soldering and a strong, long lasting bond.

Part #	Alloy Lead/Tin	Spool	Dia.	Price (1-3)	Price (4-UP)
EN-370-080	60/40	1 lb.	.031"	$10.95	$9.95
EN-370-090	60/40	1 lb.	.050"	10.95	9.95
EN-370-098	60/40	4 lb.	.031"	43.80	39.50
EN-370-072	63/37	1 lb.	.020"	13.60	12.25
EN-370-074	63/37	1 lb.	.031"	11.50	10.50

Magnetizer/Demagnetizer

Handy device to magnetize (or demagnetize) screwdrivers, tweezers, and various other tools.

#EN-360-700 .. $9.90 (1-9) $8.90 (10-UP)

36 Piece Precision Driver Set

Contains 6 individual kits. Eac Moody kit contains locking, chuck type, knurled steel handles and 5 interchangeable ends. The set includes: Slotted Screwdriver Kit (.040", .055", .070", .080", and .100" slotted blades), Cross Driver & Awl Kit (1 awl plus, .055"/1.4mm/#000, .080"/2.0mm/#00, .100"/2.5mm/#0, and .125"/3.2mm/#1 cross recess blades), Hex Driver Kit (.035", .050", .062", .078", and .093" hex blades), Torx® Driver Kit (T-6, T-7, T-8, T-9, and T-10 Torx blades), Socket Wrench/Nut Driver Kit (5/64", 3/32", 7/64", 1/8", and 5/32" socket wrenches), and Open End Wrench Kit (7/64", 1/8", 5/32", 3/16", and 1/4" open end wrenches). Includes black leatherette case.

#EN-361-215 $65.90 (1-3) $59.90 (4-UP)

12V, 15 Ah Battery

Save big on this rechargeable lead acid battery. Has many uses: computer back-up upgrade, alarm back-up battery, garden tractor starter battery, and more. Sealed in a high impact polystyrene case. Bolt and nut type terminals. Dark blue color. Dimensions: 7"W x 6-1/2"H x 2-15/16"D. Net weight: 14 lbs. Limited availability.

#EN-149-100 ..... Compare to $60.00 ..... $29.95 (1-4) $24.95 (5-UP)

Chamois Swabs

Genuine sheepskin swabs for cleaning delicate video and audio heads. Chamois leaves no residue. 10 pieces per package. Reusable.

#EN-200-028 $2.95 (1-9 PKGS) $2.60 (10 PKGS-UP)

FREE CATALOG

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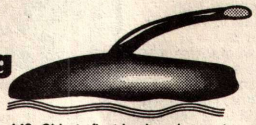

Remember War of the World? Objects float in air and move to the touch. Defies gravity, amazing gift, conversation piece, magic trick or great science project.

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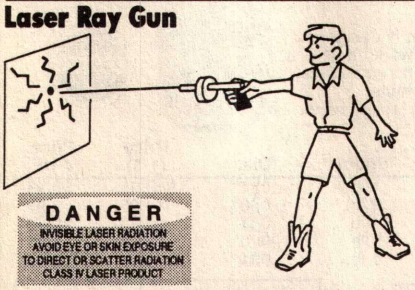
Laser Ray Gun



Advanced project produces a burst of light energy capable of burning holes in most materials. Hand-held device uses rechargeable batteries. 500 joules of flash energy excite either a neodynium glass, yag or other suitable 3" laser rod. This is a dangerous CLASS IV project (individual parts/assemblies available). **LAGUN1 Plans $20.00**

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Beeper device, 3 mile range.

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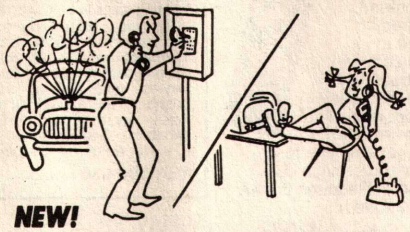
Highly sensitive stethoscope mike.

STETH1 Plans.....$8.00 STETH1K Kit/Plans $44.50



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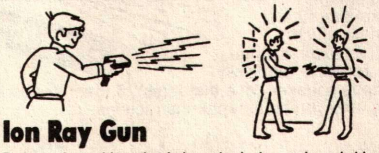

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Projects charged ions that induce shocks in people and objects without any connection! Great science project as well as a high tech party prank. **IOG3 Plans $8.00**

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IPG70 Assembled $74.50

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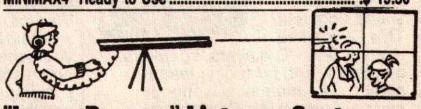

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3mw Visible Red Pocket Laser

Utilizes our touch power control!

VRL3KM Kit / Plans..... $74.50

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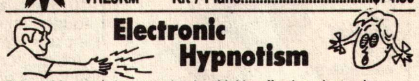

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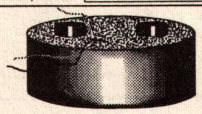

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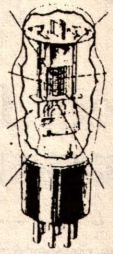

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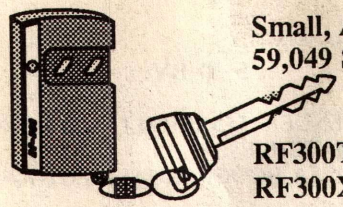

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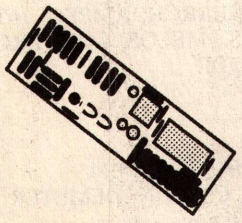

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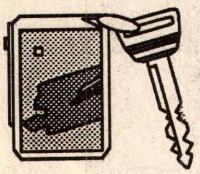

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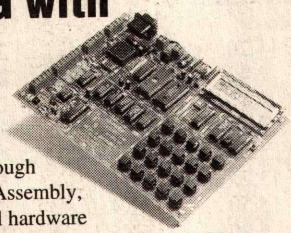

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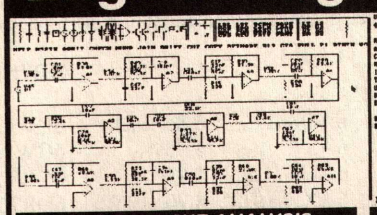

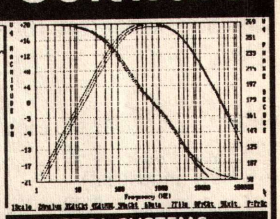

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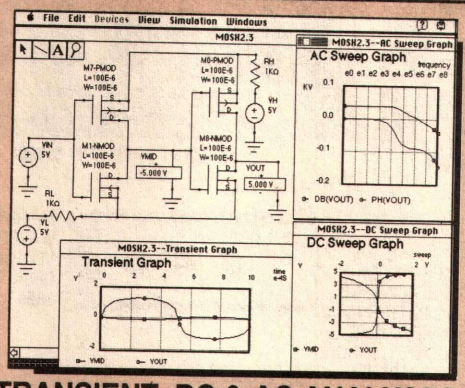

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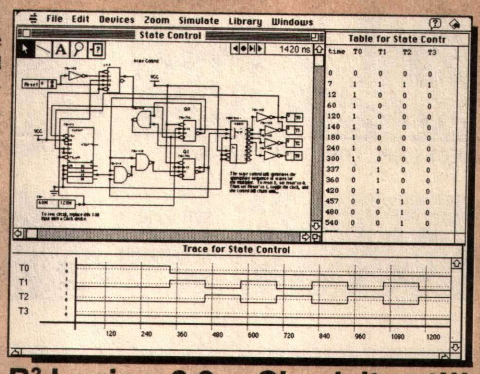

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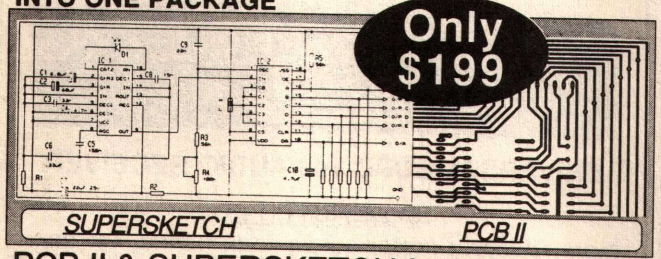

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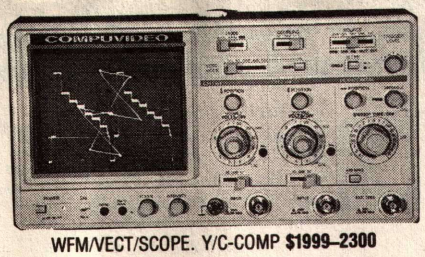

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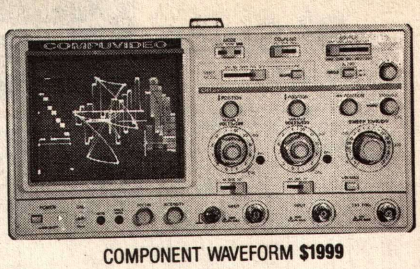

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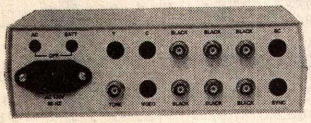

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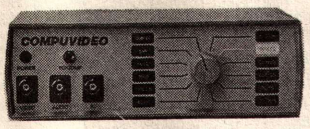

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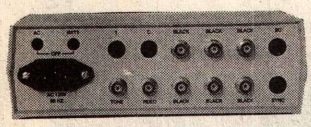

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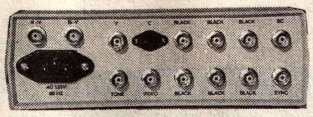

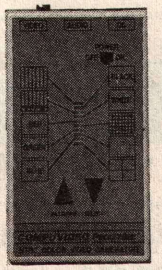

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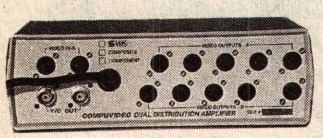

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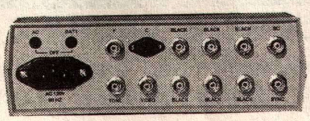

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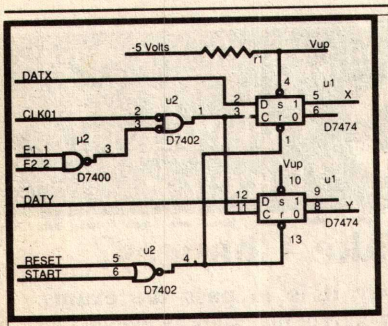

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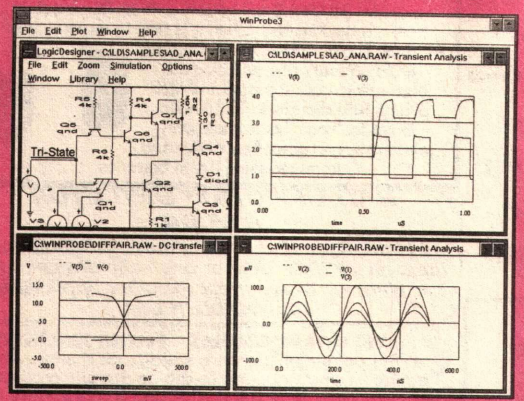

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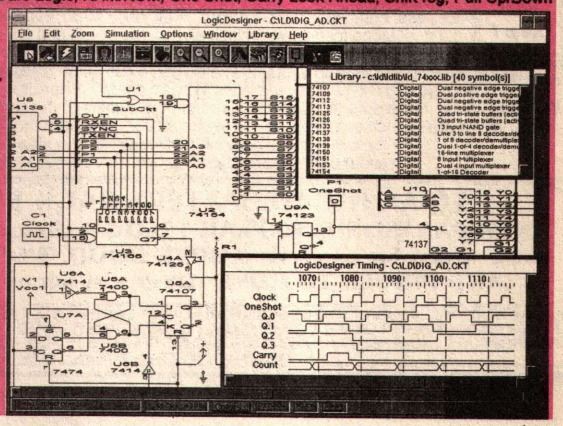

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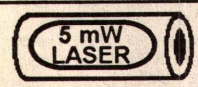

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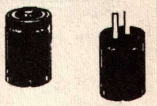

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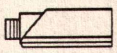

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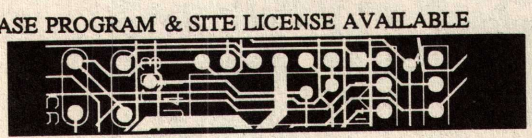

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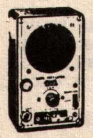

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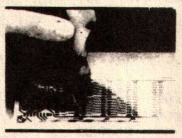

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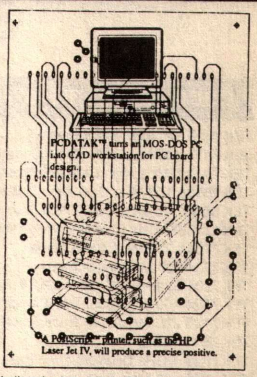
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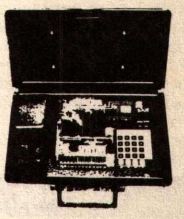

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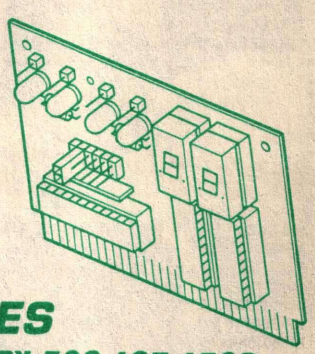

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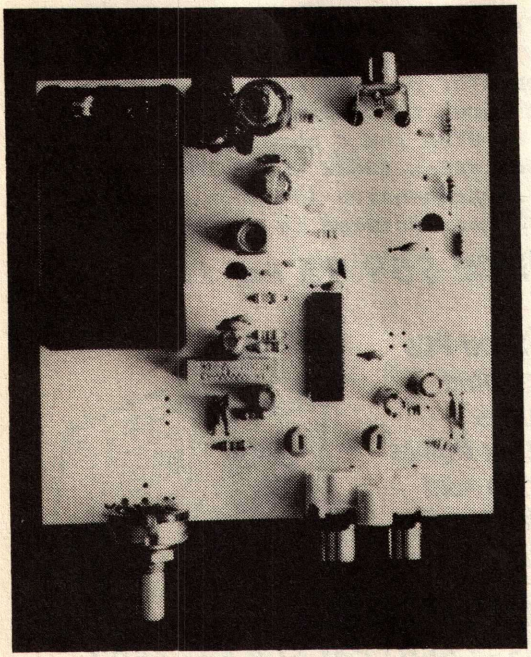

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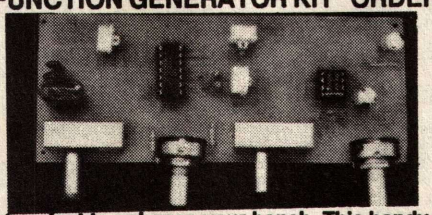

A great project to enhance your bench. This handy little function generator has a built-in buffer amplifier, a 3-decade range selector switch that covers 15 hZ to 25 khZ, output level control and function switch to select sine, square, or triangle.

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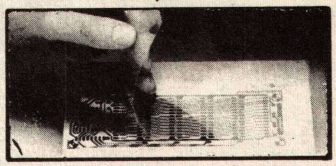

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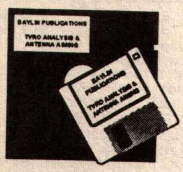
KU-BAND SYSTEM

Package INCLUDES all of this:

- 3ft Quality alum dish
- Pansat BR 1100 Receiver
- Polar tracking mount
- Polarity switching feed
- Low Temperature LNB
- 100ft All in one ribbon cable
- Site data coordinate sheet

***Complete System Only $499**



Satellite Analysis and Antenna Aiming Software

An extremely valuable tool for designing and installing TVRO's, tailored for ease of use by professionals and dealers as well as by technically orientated TVRO owners. Demonstrates how changing parameters such as dish size or LNB noise temperature affect picture quality. The program performs both TVRO system analysis and antenna aiming. The analysis subcomponent, is especially useful for predicting performance when viewing signals from a particularly weak satellite. The aiming subcomponent calculates azimuth and elevation angles and range to all satellites within "view" of a TVRO. The names and latitudes of all world-wide C and Ku-band broadcast satellites, presently in service or to be launched by 1995, are listed. The user simply enters TVRO site latitude and longitude.

5.25" disk $49.95
3.5" disk $49.95

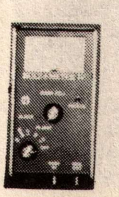
SATELLITE SYSTEM DO-IT-YOURSELF INSTALLATION VIDEO

"Now You Can Watch It Being Done"

Install or "Tune up" your satellite system in no time flat with this professional video.

VHS or Beta (45 Min.)..... $33.95

Pico dish Tuning Meter



Bulz-I-Tuning Meter Now with audio alert

TUNE YOUR DISH TO IT'S MAXIMUM!

Dish tuning meters are a must for the serious dealer or satellite system owner. Saves time, frustration and money. Use when installing a new system, moving your dish, re-alignment of a dish that has been moved by wind, frost heaves etc., gets you right on the satellite belt for the best possible pictures!

Pico meter (meter tuning) $89.95
Bulz-I-IV meter (meter & audio alert)..... 154.95

C-BAND SYSTEM

Package INCLUDES all of this:

- 7ft ORBITRON mesh dish
- uniden 4400 IRD
- Polar tracking mount and motorized arm
- Chaparral Polarity switching feed
- 25°Low Temperature LNB
- 100ft All in one ribbon cable
- Optional Decoder module

*All you need to supply is ground pole to mount dish on. (3.5" O.D.)

***Complete System Only $859**

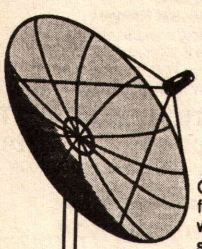
LNBs

New Lower Temp's

Hemt Technology Commercial Grade

35° LNB C-band 4GHz ..... $ 79
25° LNB " " 95

0.9db LNB Ku-band 12GHz ..... $ 89
0.7db LNB " " 99
0.6db LNB " " 119



MESH DISHES by ORBITRON

Quality Demonstrated by Performance

Orbitron antennas ("size for size") are known the world over for their superior reception and picture quality.

7ft	dish & polar tracking mount	$259
8.5ft	" "	319
10ft	" "	369
10ft H D.	" "	449
12ft	" "	649

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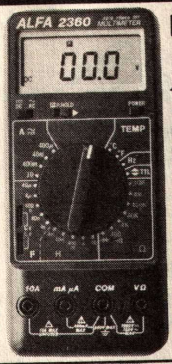
DMM 89 $199.95

Most Advanced DMM

All Purpose & Communication

-80.7 to 81.4 dBm with 4Ω –1200Ω
20 reference impedances
True RMS
Frequency counter: 0.01Hz-10MHz
Capacitance: 1pF-50,000µF
Measure AC volt to 20kHz
5000 counts, 0.1% accuracy
Auto/manual range, fast bar graph
Min/Max/Ave/DH/Relative/Zoom
Auto power off
Input warning
Splash proof
Volt, amp, ohm, logic, diode, continuity
Ruggerdized case
Rubber holster included

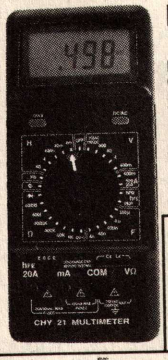


DMM 2360 $119.95

DMM+LCR Meter

Very Versatile DMM

Inductance: 1µH-40H
Capacitance: 1pF-40µF
Frequency: 1Hz - 4MHz
Temperature: -40-302 °F
TTL Logic Test: 20MHz
Diode, Continuity
Volt, Amp, Ohm
3999 count display
Peak Hold
Auto power off
Ruggerdized case.
Rubber Holster $8.00
Temperature probe $7.00



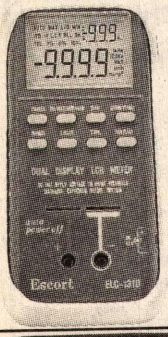
DMM 21 $74.95

Inductance: 1µH-40H
Capacitance: 1pF-200 F
Frequency: 1Hz-1MHz
Volt, amp, ohm, diode, continuity
3999 count display
TTL logic, HFE
Peak hold
Ruggerdized case
Rubber holster $8.00

Full line of DMMs, economy, compact, ruggerdized, solar cell, automotive, heavy duty, industrial, starts from $15.95

Fluke Multimeter

Fluke 12	$84.95
Holster C-10	$10
Fluke 70 II	$67.5
Fluke 73 II	$94
Fluke 75 II	$129
Holster C-70	$16
Fluke 77 II	$149
Fluke 79 II	$169
Fluke 29 II	$169
Fluke 83	$225
Fluke 85	$259
Fluke 87	$287
Fluke 97 Scope Meter	$1785



LCR Meter 131D $229.95

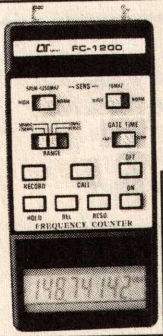
Most Advanced LCR

Dual display:L/Q or C/D
Inductance: 0.1µH-1000H
Capacitance:0.1pF-10,000µF
Impedance:1mΩ-10MΩ
0.7% basic accuracy
Dissipation factor & Q factor
Serial & parallel mode
Relative mode for comparison and to remove parasitics
Statistics, tolerance,
Best for design, incoming testing & production
SMD and chip component test probe $25.00

LCR Meter 814 $189.95

Best Resolution LCR

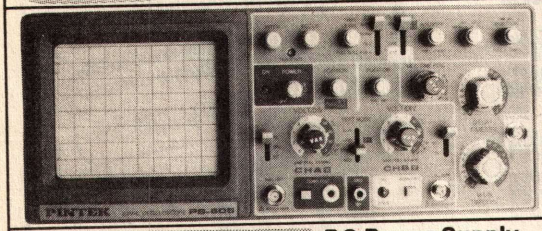
Inductance: 0.1µH-200H
Capacitance: 0.1pF-20,000µF
Resistance: 1mΩ-20MΩ
1% basic accuracy
Dissipation factor indicates leakage in capacitor and Q factor in inductor
Zero adjustment to reduce parasitics from test fixture
Best for high frequency RF and surface mount components.
SMD and chip component test probe $25.00, Deluxe carrying case $5.00



Frequency Counter FC-1200 $129.95

Frequency:0.1Hz-1.25GHz
Display: 8 digit LCD
Period: 0.1µs-0.1s
Records Max/Min/Average
Data hold, relative mode
Telescoping antenna $8.00
Deluxe case $5.00

Also Available:
AC/DC clamp meter,Light meter, Thermometer, pH meter, High voltage probe, Digital caliper, Anemometer, Electronic scale, Force gauge,Tachometer, Stroboscope, Humidity & EMF adapter, Sound level meter, Frequency counter, SWR/field strength/power meter, Dip meter



20 MHz Oscilloscope with Delay Sweep PS-205 $429.95

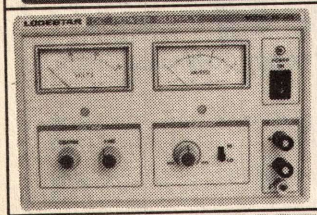
Dual Trace, Component test, 6" CRT, X-Y Operation, TV Sync, Z-Modulation, CH2 Output, Graticule Illum, 2 probes each has x1,x10 switch. Best price with delay sweep.

PS-200 20 MHz DUAL TRACE	$339.95
PS-400 40 MHz DUAL TRACE	$494.95
PS-405 40 MHz DELAY SWEEP	$569.95
PS-605 60 MHz DELAY SWEEP	$769.95

Scope Probe: 60MHz x1, x10 $13, 100MHz x1, x10 $22

20 MHz Digital Storage Oscilloscope DS-203 $729.95

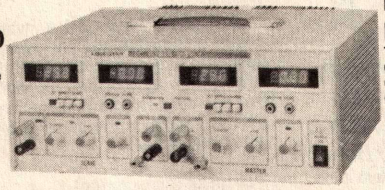
Switchable between digital and analog modes
2 K word per channel storage
Sampling rate: 10 M sample /sec
8 bit vertical resolution (25 Lerel/div)
Expanded Timebase 10ms/div - 0.5 s/div
Refresh, Roll, Save all , Save CH2, Pre-Trig
Plotter Control
250MHz x1, x10 $29, 250MHz x100 $39



DC Power Supply PS-303 $159.00

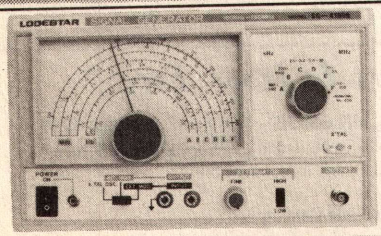
0-30 VDC , 0-3A output

Constant voltage & constant current mode
0.02% + 2mV line regulation
0.02% + 3mV load regulation
1 mVrms noise and ripple
Short circuit and overload protected
PS-8200 with digital voltmeter $179.00
Also available: 30V/5A, 60V/3A, 60V/5A 16V/10A, 30V/10A



DC Power Supply Triple Output PS-8202 $499.95

Two 0-30 VDC , 0-3A outputs
One fixed 5VDC, 3A output
Capable of independent or tracking operation
Constant voltage and constant current mode
Four digital meters for volt and current display
Excellent regulation and low ripple
Short circuit and overload protected
Also available: 30V/5A triple output $549.95
Dual tracking 30V/3A, 30V/5A, 60V/3A, 60V/5A



RF SIGNAL GENERATOR SG-4160B $119.00

100 kHz-150MHz sinewave in 6 ranges
RF Output 100mVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz
AM modulation
Audio output 1 kHz, 1 Vrms

AUDIO GENERATOR AG-2601A $119.00

10Hz - 1MHz in 5 ranges
Output: 0-8Vrms sinewave
0-10Vp-p squarewave
Synchronization: ±3% of oscillation frequency per Vrms
Output distortion:
0.05% 500Hz - 50kHz
0.5 % 50Hz - 500kHz
Output impedance: 600 ohm

FUNCTION GENERATOR FG-2100A $169.95

0.2 Hz -2 MHz in 7 ranges
Sine, square, triangle, pulse and ramp
Output: 5mV-20Vp-p
1% distortion, DC offset ± 10V
VCF: 0-10V control frequency to 1000:1

FUNCTION GEN/COUNTER FG-2102AD $229.95

Generates signal same as FG-2100A
Frequency counter 4 digits
Feature TTL and CMOS output

RF SIGNAL GEN./COUNTER SG-4162 AD $229.95

Generates RF signal same as SG-4160B
Frequency counter 1Hz - 150 MHz for internal and external source
Sensitivity <50mV

AUDIO GEN./COUNTER AG-2603AD $229.95

Generates audio signal same as AG-2601A
Frequency counter 1Hz-150MHz for internal and external sources
Sensitivity <50mV

SWEEP FUNCTION GEN./COUNTER $329.95

0.5Hz to 5 MHz in 7 ranges
Sweep: Linear 10:1/Log 10:1 20ms to 2s
AM Modulation
Gated Burst, Voltage Control Generator
Generator Control Voltage & 6 digit counter
1Hz-10MHz for internal & external sources

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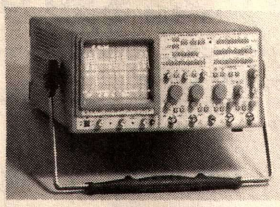
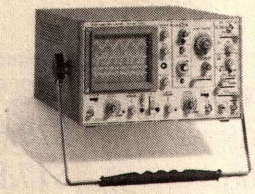
ISO 9002 CERT. #934163

100 MHz Cursor Readout Scope 4 ch, 8 traces OS-6101 $1,499.95



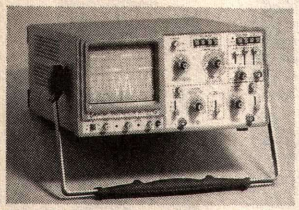
* 4 independent channels, 8 traces
* Time /Voltage cursor measurement
* ALT triggering function for 4 ch.
* Sweeps to 2ns/div, Delayed Sweep
* TV Sync., Ch. 1 output, Z-axis input
* 2 probes(x1, x10)

100 MHz Scope, 4ch. 8 traces Best value all purpose scope OS-6100B $1,329.95



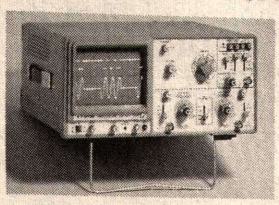
* 4 channels, 8 traces
* High sensitivity 500μV/div
* Sweeps to 2ns/div, Delayed sweep
* 20 kV accelerating voltage
* TV sync., Z-axis input
* A and B gate output
* Best price 100 MHz scope
* 2 probes(x1, x10)

50 MHz Triggering Oscilloscope OS-653 $699.95



* Dual Channel
* Hold Off Function
* Delayed Sweep
* Built-in Delay Line
* TV Sync
* ALT Triggering
* High sensitivity 1 mV/div
* Trigger level lock function
* Z-axis input, CH1 output
* 2 probes(x1, x10)

20 MHz Oscilloscope OS-622B $344.95



* Dual trace, X-Y operation
* TV Sync., Z-axis input,CH 1 output
* High sensitivity 1 mV/div
* Trigger level lock
* 2 probes (x1, x10)

OS-645B - 40 MHz Cursor readout.....$ 734.95
OS-625B - 20 MHz Cursor readout.....$ 549.95
OS-623B - 20 MHz w/Delayed Sweep.....$ 449.95
OS-935 - 5 MHz One channel.....$ 209.95

DC Linear Power Supplies Single Output

* Constant voltage and constant current mode
* Voltage regulation ≤0.01%
* Current regulation ≤0.2%
* Low ripple and noise
* Overload and reverse polarity protection
* Features 2 analog or 1 digital meter(PS series) 2 analog or 2 digital meters(PR series)

PS-1830 : (0-18V, 0-3A).....$194.95
PS-1830D : Digital Display.....$204.95
PS-1850 : (0-18V, 0-5A).....$204.95
PS-1850D : Digital Display.....$229.95
PS-3225 : (0-32V, 0-2.5A).....$199.95
PS-3225D : Digital display.....$219.95
PS-6010 : (0-60V, 0-1A).....$199.95

PR-1810H : (0-18V, 0-10A).....$329.95
PR-3060 : (0-30V, 0-6A).....$299.95
PR-6030 : (0-60V, 0-3A).....$299.95
PR-6030D : Digital Display.....$399.95

Triple Output DC Power Supplies

* Two variable 0-30VDC, 0-3A outputs
* One fixed 5VDC, 3A output
* Auto tracking
* Auto serial and parallel operation
* Constant voltage and constant current mode
* Continuous/dynamic load can be selected
* Features 4 analog or 2 digital displays

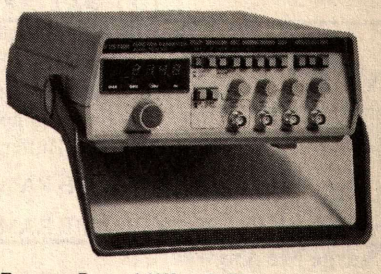
PC-3030 : (0-30V, 0-3Ax2).....$479.95
PC-3030D : Digital display.....$509.95

Programmable DC Power Supplies

* High stability , low drift, 4 digit display
* Front/rear output-sense switch selectable
* Auto step running w/timer settings
* 100 point programmability (PPS series)
* 50 point programmability (PPT series)
* Auto serial and parallel operation (PPT series)
* Auto tracking (PPT series), IEEE-488.2 and SCPI compatible command set (optional)

PPS-1860G: (0-18V, 0-6A).....$999.95
PPS-3635G: (0-36V, 0-3.5A).....$999.95
PPS-6020G: (0-60V, 0-2A).....$999.95
PPT-1830G: (0-18V, 0-3Ax2, 0-6V, 0-5A).....$1299.95
PPT-3615G: (0-36V, 0-1.5Ax2, 0-6V, 0-3A).....$1299.95

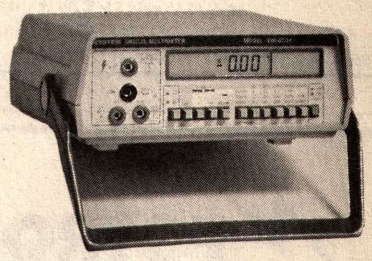
Digital Display Function Generator FG-8016G $239.95



* Frequency Range: 0.02Hz to 2MHz
* Three Instruments in one: Function generator, Pulse generator & Frequency counter.
* Sine, Triangle, Square, TTL Pulse and CMOS output
* Built-in 6 digit counter with INT/EXT function
* 1000:1 tuning range
* Variable DC offset control

FG-8015 Function Generator
* 0.02Hz-2MHz (No Counter).....$189.95
FC-8131 Intelligent Counter 1.3GHz.....$469.95
FC-8270 Intelligent Counter 2.7GHz.....$599.95
UC-2010G Universal Counter.....$289.95

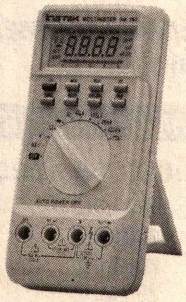
Digital Multimeter & C Meter DM-8034(3½ digits) $179.95



* 8 Function, AC/DC voltage, AC/DC current, resistance
* Built-in C meter, diode test and audible continuity check
* High voltage 1000V and 20A range
* 0.5% basic accuracy

DM-8040 (3¾ Digits, True RMS)
* Measures ACV to 50 kHz.....$339.95
DM-8055 (5½ Digits).....$649.95
* 0.006% basic accuracy
* 1μV, 1mΩ, 1nA resolution
* dBm measurement
* Auto range, relative mode, Max/Min

DM-8055G(5½ Digits, GPIB).....$889.95



Model DM-392 (3¾ digits) $109.95

* Auto/Manual ranging(38 ranges)
* 42 Segment analog bar graph
* Data Hold/Min-Max memory /Relative mode
* Auto power off
* Overload protection
* Audible continuity check /diode test
* Capacitance: 1pF-40μF
* Frequency: 0.1Hz-1MHz
* 20 Amp range
* Double high energy fused (1A, 20A)
* 0.3% DCV accuracy
* **AC True RMS** (DM-394 only)

DM-351 : 3½ Digits w/Continuity, Auto Off.....$54.95
DM-352 : 3½ Digits, Cap. Freq. hFE, 20 Amp.....$79.95
DM-353 : 3½ Digits, Cap. Freq. Temp. hFE.....$84.95
DM-391 : 3¾ Digits, Auto, Cap. Freq. Min/Max....$99.95
DM-392 : 3¾ Digits, Hold, Min/Max 20Amp.....$109.95
DM-393 : 3¾ Digits, Peak, Logic, hFE, Freq.....$119.95
DM-394 : 3¾ Digits, TRMS, Same as DM 392....$129.95

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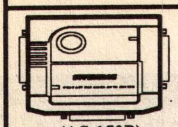
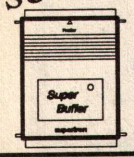


(AS-152P)

NON-POWERED AUTO SWITCH
Compact Size, Remote Parallel Switch
I. 2 or 4 PCs SHARE 1 PRINTER
MP-201N 2 TO 1 **$11.99** MP-471 4 TO 1 **$19.99**

II. **BI-DIRECTIONAL** TYPE *Software Included
2 or 4 PC Share 1 Printer or 1 Printer shares 2 or 4 PCs
AS-152P 2 TO 1 **$21.99** AS-154P 4 TO 1 **$29.99**

SUPERB!



FLASH PRINTER/PLOTTER BUFFER
*Compression Technology Shorttens 85% PC Download Printing Time
File Copy Function up to 255 Copies
LED Indicator /Buffer Speed: 67.5 KB/Sec.
SB-190(W/1 MB RAM) **$89.99**
SB-290(W/2 MB RAM) **$119.99**

Charge Me Anywhere !!
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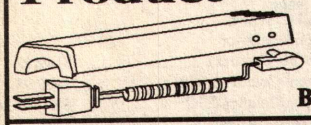

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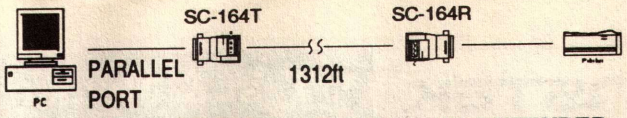

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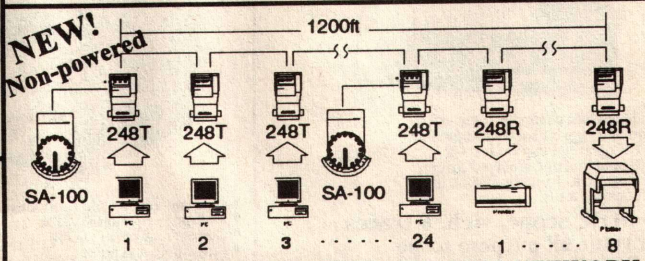

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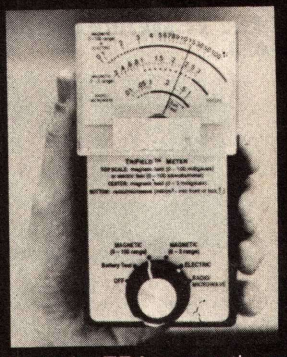

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FIBRE OPTIC TUBES

These US made tubes are "pulls" from equipment, in excellent condition. Have 25/40mm diameter, fiber-optically coupled input and output windows. The 25mm tube has an overall diameter of 57mm and is 60mm long, the 40mm tube has an overall diameter of 80mm and is 92mm long. The gain of these is such that they would produce a good image in approximately 1/2 moon illumination, when used with suitable "fast" lens, but they can also be IR assisted to see in total darkness. Our HIGH POWER LED IR ILLUMINATOR kit, and the IR filter are both suitable for use with these tubes. The superior resolution of these tubes would make them suitable for low light video preamplifiers, wild life observation, and astronomical use. Each of the tubes is supplied with an 9V-EHT power supply kit. INCREDIBLE PRICES:

$85 For the 25mm intensifier tube and supply kit.

$130 For the 40mm intensifier tube and supply kit.

We also have a good supply of the same tubes that may have a small blemish which is not in the central viewing area.

$50 For a blemished 25mm intensifier tube and supply kit.

$70 For a blemished 40mm intensifier tube and supply kit.

INTENSIFIED NIGHT VIEWER KIT

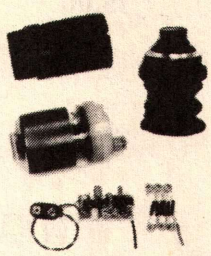
See in the dark! Make your own night scope that will produce good vision in sub-starlight illumination! We supply a three stage fiber optically coupled image intensifier tube, EHT power supply kit, and sufficient plastics to make a monocular scope. The three tubes are supplied already wired and bonded together.

$190 for the 25mm version

$320 for the 40mm version

We can also supply the lens (100mm f2: **$50**) and the eyepiece (**$12**) which would be everything that is necessary to make an incredible viewer!

IR "TANK SET"

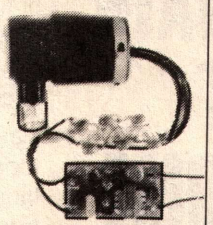


A set of components that can be used to make a very responsive Infra Red night viewer. The matching IR tube, lens and eyepiece sets were removed from working military quality tank viewers. We also supply a very small EHT power supply kit that enables the tube to be operated from a small 9V battery. The tube emloyed is probably the most sensitive IR responsive tube we ever supplied. The resultant viewer requires low level IR illumination. Basic instructions provided.

$85

For the tube, lens, eyepiece and the power supply kit. When ordering specify preference for a wide angle, or a telescopic objective lens.

IMAGE INTENSIFIER TUBE AND SUPPLY



These are the key components needed for making a PASSIVE NIGHT VIEWER. The small prefocussed Russian image intensifier tube only requires a low current EHT power supply to make it operational, which we provide in kit form: Draws 20mA from a small 9V battery. With a suitable low light objective lens (Not provided) the resultant viewer will produce useful pictures in sub-moonlight illumination, and it can also be IR assisted. ON SPECIAL:

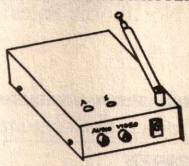
$90

For the Russian image intensifier tube and an EHT power supply Kit. All that is needed to make a complete passive night viewer is a lens, an eyepiece, a 9V battery, a case and a switch.

HIGH POWER LED IR ILLUMINATOR

This kit includes two PCB's, all on-board components plus casing: Switched mode power supply plus 60 high intensity 880nM IR (Invisible) LED's. Variable output power, 6-20VDC input, suitable for illuminating IR responsive CCD cameras, IR night viewers etc. Professional performance at a fraction of the price of the commercial product: COMPLETE KIT PRICE: **$44**

VIDEO TRANSMITTERS



Low power NTSC standard UHF TV transmitters. Have audio and video inputs with adjustable levels, a power switch, and a power input socket: 10-14V DC/ 10mA operation. Enclosed in a small metal box with an attached telescopic antenna. Range is up to 30ft. with the telescopic antenna supplied, but can be increased to approximately 100ft. by the use of a small directional UHF antenna. INCREDIBLE PRICING:

$18

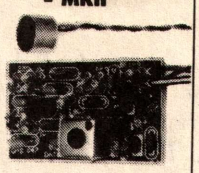
INFRA RED FILTER

A very high quality IR filter and a RUBBER lens cover that would fit over most torches including MAGLITES, and convert them to a good source of IR. The filter material withstands high temperatures and produces an output which would not be visible from a few meters away and in total darkness. Suitable for use with passive and active viewers.

$11

For the filter and the rubber lens cover.

FM TRANSMITTER KIT - MKII



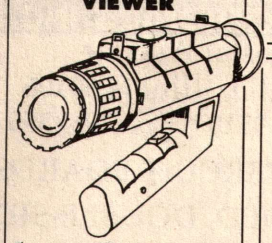
This low cost FM transmitter features pre-emphasis, high audio sensitivity as it can easily pick up normal conversation in a large room. It also has excellent frequency stability. Specifications: Tuning range: 88-108MHz, Supply voltage 6-12V, current consumption @ 9V: 3.5mA, Pre-emphasis: 75µS, Frequency response: 40Hz to greater than 15KHz, S/N ratio: Greater than 60dB, Sensitivity for full deviation: 20mV, Frequency stability with extreme antenna movements: 0.03%, P.C.B. dimensions: 1"x1.7". Construction is easy and no coil winding is necessary. The kit includes a PCB and all the on-board components, an electret microphone, and a 9V battery clip.

$8

SECOND GENERATION TUBES

We should have a regular supply of some new USSR made 18mm 2nd. Gen. Fiber optically coupled image intensifier tubes @ approx. $500 and also some used US-European made tubes @ approx. $330. Some of these may require an export permit.

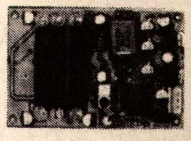
PASSIVE NIGHT VIEWER



This is a completed commercial monocular hand held night viewer, that emplous an image intensifier tube. The viewer is of a USSR military standard, and will produce useful images in very low ambient light. Has adjustable low light objective lens, adjustable eyepiece and is supplied with a carry case. ON SPECIAL:

$220

CCD CAMERA



Monochrome CCD Camera which is totally assempled on a small PCB and includes an Auto Iris lens. 9-12V DC operation. It can work with illumination of as little as 0.1 Lux, and is IR responsive: Can be used in total darkness with Infra Red illumination. A suitable illuminator is our HIGH POWER LED IR ILLUMINATOR kit. Overall dimensions of camera are 24 x 46 x 70mm and it weighs less than 40 grams. Can be connected to any standard monitor or the video input on a Video cassette recorder: EIA (US-NTSC) compatible.

$196

MINIATURE FM TRANSMITTER

Not a kit, but a very small ready made self contained FM transmitter enclosed in a small black metal case. It is powered by a single small 1.5V silver oxide battery, and has an inbuilt electret microphone. SPECIFICATIONS: Tuning range: 88-108MHz, Antenna: Wire antenna – attached, Microphone: Electret condenser, Battery: One 1.5V silver oxide LR44/G13, Battery life: 60 hours, Weight: 15g, Dimensions: 1.3" x 0.9" x 0.4".

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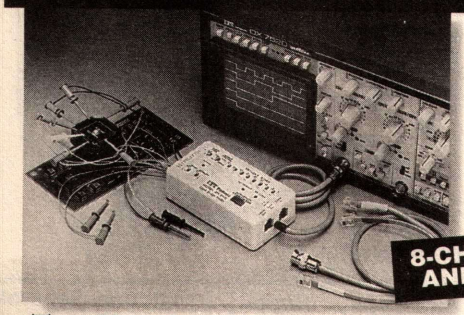

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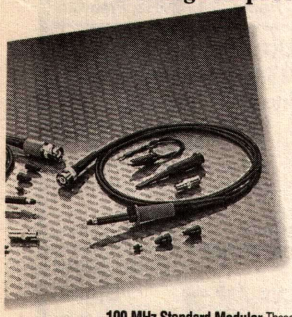
6004 Logic Scope Probe Kit $330.00



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5795	x10	1.2	10	15	100	3	600	10-60	35.00
4550A	x1-x10 Switchable	1.2	x1 x10 Same 10 as scope	x1 x10 55 16	x1 x10 15 100	x1 x10 35 3	600	10-60	43.00
5800	x1	1.2	Same as scope	45	30	10	600		41.00
5803	x10	1.2	10	15	200	1.8	600	10-60	45.00
5806	x1-x10 Switchable	1.2	x1 x10 same as as scope	x1 x10 55 15.5	x1 x10 20 200	x1 x10 10 1.8	600	10-60	49.00
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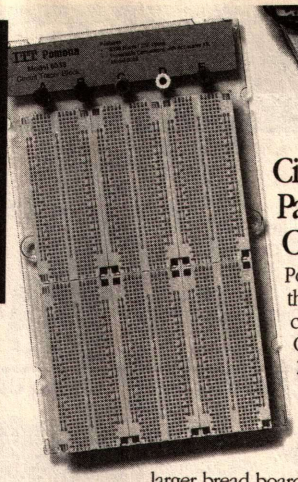

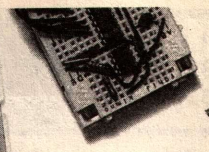

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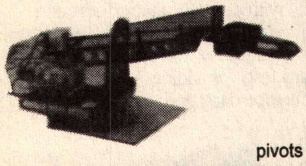

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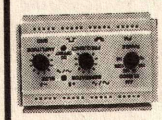

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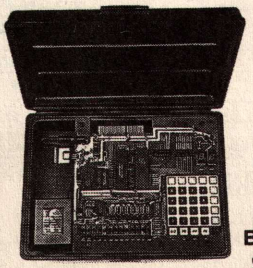

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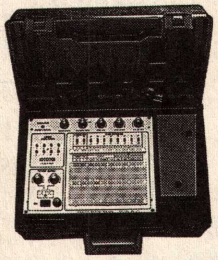

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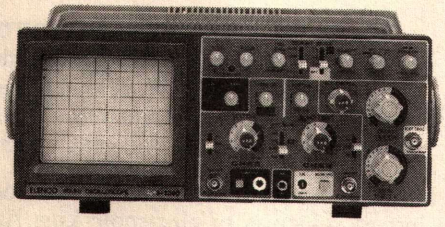

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S-1365 $849

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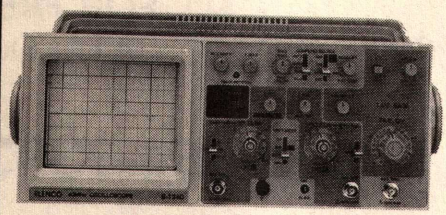

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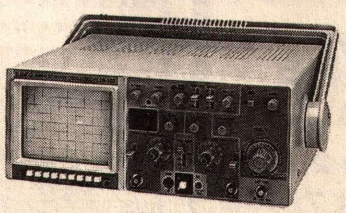

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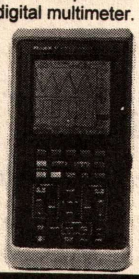

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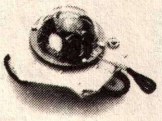

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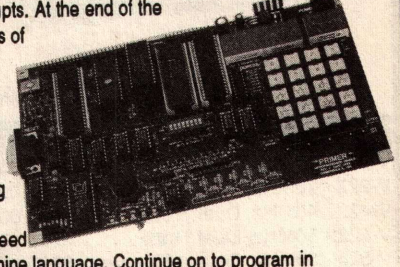

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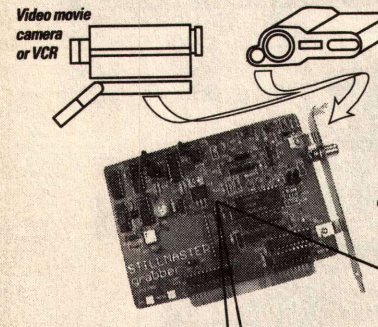

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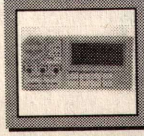

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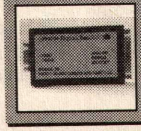

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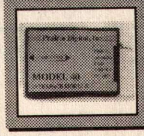

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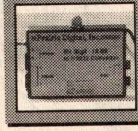

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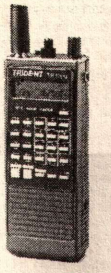

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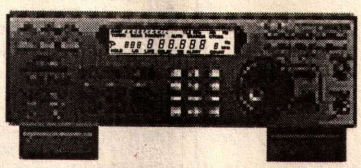

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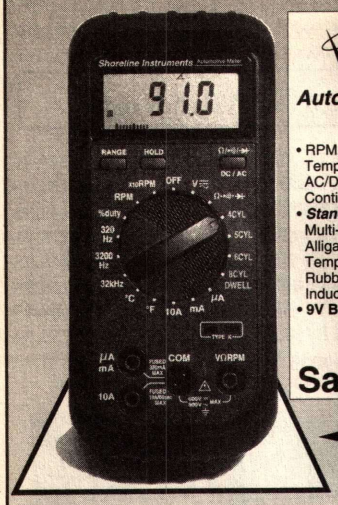

Shoreline INSTRUMENTS

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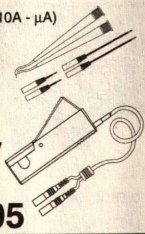

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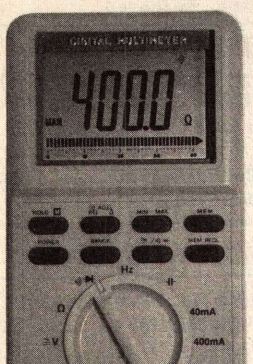

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See our **Catalog** for our infamous cellphone modification guide **($69)** - detailed, comprehensive, covers all makes - 10 times more info than competitor's "guides"). (Do **Special Projects** (below) for up-to-date hardware/software).

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How **Voice Mail Box (VMB)** systems are used and the specific ways they are hacked. Includes **ASPEN, MESSAGE CENTER, BIX, GENESIS, EZ, SYDNEY, PHONE MAIL, AUDIX, CINDY, CENTAGRAM, SPERRY LINK, RSVP,** etc. Absolutely required for all users, sysops and security personnel! **$29.**

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1,000s of PBXs are hacked to the tune of $ Billions/yr! While **"VOICE MAIL HACKING"** details how VMSs are hacked for "phun" and profit - including VMS methods for hacking PBXs themselves - **"PBX HACKING"** addresses ALL issues relating to PBX hacking, including countermeasures! Can your business or agency afford a $90,000 phone fraud loss (the average loss due to hacked PBXs)? As described in **Forbes Magazine. $39.**

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STOPPING POWER METERS

As reported on **CBS "60 MINUTES": How certain devices can slow down - even stop - watthour meters - while loads draw full power!** Device simply plugs into one outlet and normal loads into other outlets. Also describes meter creep, overload droop, etc. Plans **$29.**

I.G. MANUAL: External magnetic ways (applied to the meter itself) to slow down and stop watthour meters while drawing full loads. Plans. **$19.**

KW-HR METERS: How watthour meters work, calibration, error modes (many), ANSI Standards, etc. **Demand** and **Polyphase Meters.** Experimental results to slow and stop meters by others. **$19.** Any 2, **$38.** All 3, **$59.**

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ATM crimes, abuses, vulnerabilities and defeats exposed! 100+ methods detailed, include: Physical, Reg. E, cipher, PIN compromise, card counterfeiting, magnetic stripe, false front, TEMPEST, Van Eck, tapping, spoofing, inside job, super-cool, vibration, pulse, high voltage - others. Case histories, law, countermeasures, detailed security checklist, labeled internal photos, figures. ATMs contain up to $250,000 in cash! Recent $350,000 ATM crime spree still unsolved! **$39.**

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Cardholders, merchants, banks suffer $ Billions in losses annually because of credit card fraud. Describes every known means of credit card fraud and scams. **Protect yourself! $29.**

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Cons & scams fleece Americans of $100+ Billion per year! The most comprehensive survival manual on cons & scams of all kinds - from the classic to hi-tech. Details on 100s and their many variations. **Protect yourself! $29.**

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Electromagnetic Interference and Electronic Weapon Attacks cause: Cancer, birth defects, and profound psychological, neurological, cardiovascular and immune system disorders! Destructive to people, animals, plants, equipment! Includes **ACTUAL CASES OF EM ATTACKS ON PEOPLE** (we investigated)! Includes how to verify and pinpoint EMI and electronic attack sources, and specific countermeasures. **$29. EM BRAINBLASTER:** Tutorial and plans for powerful **ELECTROMAGNETIC WEAPONS** and **LAB DEVICES.** Optimum circuits, freqs, waveforms, duty cycles, intensities. Thorough. **$29.** Both **$49.**

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Covers all hard drive and controller implementations (emphasis on PCs). How to select, interface, initialize, set up, use, maintain, troubleshoot and repair them. How to protect them from mistakes, sabotage, prying eyes and sticky fingers. How to recover damaged and lost files. How to prevent crashes. Includes software reviews. Loaded with information, advice, tips. **$29. DISK SERVICE MANUAL:** Maintain, troubleshoot, repair, adjust, align floppies without special equipment or software. **3.5"/5.25"/8". PC/XT/AT/386/486, Apple, Commodore,** etc systems. All floppies need occasional upkeep. **$29. DISK DRIVE TUTORIAL:** Theory, practical facts on floppy drives, disks, including many tips, recommendations, formatting, interfacing, FDC, etc. **$24.** Any 2, **$49.** All 3, **$69.**

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PANASONIC TZ-PC 145362	$68	$64	DRX-3 PJ	$37	$33
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8600	$275	$265	DPV-5	$145	$130
8590	$260	$250	DP-5	$125	$110
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PIONEER GREEN	$65	J-TVT-GOLD	$42
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Mark V has more than 60 kits available including high-fidelity audio products, laboratory equipment, power supplies, light controllers, games and numerous projects! Audio amplifiers range from 6 to 300 watts. Kit skill levels are specified as ▲ beginner, ▲▲ intermediate, or ▲▲▲ advanced. Quality kits at unbeatable prices starting from $ 7!! Shipping within 48 hours. Foreign orders from Mexico, South America or European countries are welcome. In business since 1985.

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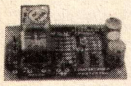
SEE OUR CATALOG FOR MORE KITS !

STEREO LOUDSPEAKER PROTECTOR

TY-25 ▲



Super fast acting relay protects speakers against destructive DC voltages. Can connect directly to a power amplifier or can use a separate power supply. Has a 3 second turn-on delay to avoid turn-on thumps. (1 lb.)

Kit: $ 16.75

REGULATED DC POWER SUPPLY

TR-503 ▲▲

It is short circuit proof and has overload protection. Output voltage is variable over a range of 0-50 volts. Current limit trip is adjustable up to max of 3A. May use Mark V #002 transformer. (1 lb.)

Kit: $ 18.75

FLUORESCENT LIGHT DRIVER

TY-2 ▲ (1 lb.)

This unit drives 6-40 watts fluorescent light for portable and emergency use. Works from a 7.2 - 16 VDC battery. Includes a "Hi-Efficiency Switching Mode IC Driving Circuit" suitable for use with different lights.

Kit:$ 14.75

120-250W MOSFET POWER MONO AMPLIFIER AF-2 (6 lbs.) ▲▲

Power Output: 250W into 4 ohms RMS(42VX2 6A transformer is used). 120W into 4 ohms RMS(33VX2 4A transformer is used). Frequency Response: 3Hz-22,000Hz. THD: <0.03%. Signal to Noise Ratio: 91dB. Sensitivity: 1V RMS at 47k. Load Impedance: 4 or 8 ohms. Power Requirement: ±46VDC 4A or ±60VDC 6A. May use Mark V model 012 Transformer. Suggested Capacitor 10,000uf 100V Model 019. Suggested Metal Cabinet LG-1925.

Kit: $ 89.80 Asmb.$ 114.80

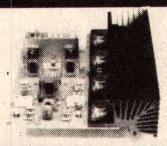
SURROUND SOUND PROCESSOR

SM-333 ▲▲ (5 lbs.)

It has inputs for VCR, LD, CD and can also be used with tuners, tape decks and LP discs. Frequency Response: 20 Hz-20KHz. THD:Front Channel 0.05% Rear Channel <0.25%. Input signal voltage: 0.1-3.5V. Output: Front Channel 0.1-3.5V Rear Channel 6.6V. Delay Time: 5-50 ms. Input Impedance: 47K Power Requirement: 100-120VAC, 60Hz. Ready to plug when assembled. Asmb:$85.00

Kit:$73.00

300W HIGH POWER MONO AMPLIFIER TA-3600 (5 lbs.) ▲▲▲

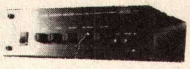


Power Output: 300W into 8 ohms RMS. 540W music power into 8 ohms. Frequency Response: 10Hz-20KHz. THD: < 0.05%. Sensitivity: 1V RMS at 47K. Power Requirement: 60 to 75 VDC at 8A. May use Mark V Model 007 or 009 Transformer. Suggested Capacitor: 10,000uf80-100V Model 019 Capacitor. Suggested Metal Cabinet LG-1925.

Kit 89.00
Asmb.$ 115.00

AC/DC STEREO PRE & MAIN AMP.

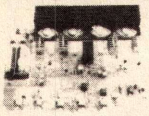
SM-720 ▲▲ (7 lbs.)



120WX2 Music Power THD: <0.2%. Input Sensitivity: Tape 300mV 47K, CD/Aux 300mV 47K, Phono 3mV 47K, Guitar/Mic 3mV (600 ohm - 47k ohm). Tone Control: Treble±8dB, Bass±8dB. Frequency Response: 20Hz-20KHz. Signal to Noise Ratio: 78dB. Power Requirement: AC 110/60Hz DC 12-16V. Ready to plug in when assembled. Asmb:$ 92.00

Kit:$ 77.00

120W + 120W PRE & MAIN STEREO AMPLIFIER TA-800MK2 (4 lbs.) ▲▲



Power Output: 120W into 4 ohms RMS. 72W into 8 ohms RMS. Frequency Response: 10 - 20 KHZ. THD: < 0.01%. Tone Control: Bass ±12dB, Mid ±8dB, Treble ±8dB. Sensitivity: Phono Input, 3mV into 47K. Line, 0.3V into 47K. Signal to Noise Ratio: 86dB. Power Requirement: 40V DC @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Metal Cabinet Model LG-1924.

Kit: $ 67.92 Asmb.$ 79.95

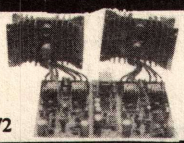
60+60W STEREO POWER AMP. ▲▲

SM-302 (11 lbs.)

It provides 3 input jack pairs. One pair accept a high impedance microphone. The two remaining pairs are for high & low level input sources. Power Output: 60W per channel into 4 ohms RMS. 20Hz-20KHz. THD:<0.1%. Input Sensitivity :Mic /Guitar 10mV, Hi 380mV, Lo 640mV.Ready to plug in when assembled. Asmb.:$ 87.00

Kit:$ 75.00

80W + 80W PURE DC STEREO MAIN POWER AMPLIFIER TA-802 (4 lbs.) ▲▲



Power Output: 80W per channel into 8 ohms. THD: < 0.05%. Frequency Response: DC to 200 KHZ, -0 dB, -3dB @ 1W. Power Requirement: 30V AC X 2 @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Capacitor 8,200uf 50V Model 017. Suggested Metal Cabinet LG-1924

Kit: $ 49.94
Asmb.$ 63.72

3½ MULTI-FUNCTION LED DPM ▲▲

SM-43 (1 lb.)

AC/DC Voltage range: 1mV-1000V. Thermometer range :0-100C. DC current range: 1 microamp - 2 amp. Capacitance range: 1pf to 2 microfarads. Frequency Counter: 10HZ-20KHZ. Max indication ±1999. Power Supply: 5-6V DC, 200ma. Asmb:$ 44.00

Kit: $ 35.50

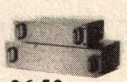
30W + 30W PRE & MAIN STEREO AMPLIFIER TA-323A (1 lb.) ▲

Power Output: 30W into 8 ohms RMS per channel. THD: < 0.1% from 100 HZ to 10 KHZ. Sensitivity: Phono 3mV @ 47K. Tuner, Tape 130mV @47K. Signal to Noise ratio: 80dB. Power Requirement: 22 to 36V AC, 3A. May use Mark V Model 002 Transformer. Suggested Cabinet LG-1684.

Kit: $ 32.50 Asmb.$ 42.50

METAL CABINETS

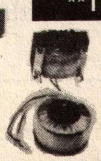
ALUMINIUM FRONT PANEL



LG-1273	3X12X7"	(4 lbs.)$	26.50
LG-1684	4X16X8"	(7 lbs.)	32.50
LG-1924	4X19X11½"	(10 lbs.)	38.25
LG-1925	5X19X11½"	(10 lbs.)	42.00
LG-1983	2¼X19X8"	(7 lbs.)	35.25

TRANSFORMERS (5-12 lbs.)

**TOROIDAL TRANSFORMERS

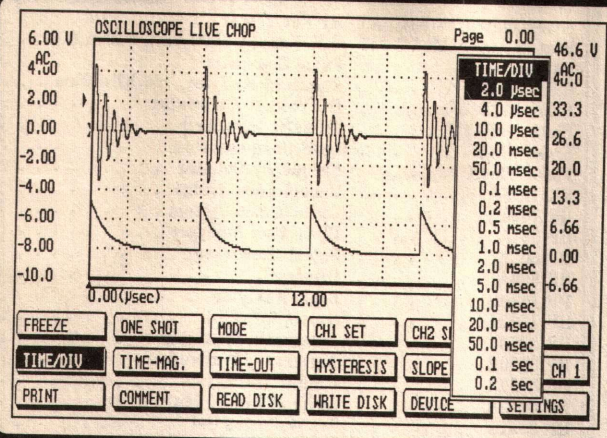


# 001	28V/30V X2	6A	$ 30.00
# 002	36V X2	3A	25.00
# 003	40V X2	6A	32.00
# 008**	28V/30V X2	6A	40.00
# 009**	48/53V X2	8A	66.00
# 012**	33/40/42V X2	6A	48.00

Minimum order $ 20.00 We accept Visa, MasterCard, Money Orders, and Checks(allow 2 weeks for clearance) We ship by UPS ground inside US (min $4.00) and ship by US mail outside US. Please call our operator for orders over 2 lbs. or foreign orders.

CIRCLE 328 ON FREE INFORMATION CARD

DATA ACQUISITION WITH THE PC



CONWAY Engineering, Inc. distributes the complete range of computer controlled measuring instruments of **TiePie** engineering. Connecting these instruments to a PC (MS-DOS 3.0 or higher) results in a number of comprehensive test instruments:

- oscilloscope;
- voltmeter;
- spectrum analyzer;
- frequency meter;
- transient recorder.

All measured data can be stored on disk or be printed out. Because of the many trigger possibilities you can measure a variety of signals, while the powerful software enables you to carry out a multitude of measurements in a straightforward manner. Application areas: service; medical research; automatic test systems; research and development; and education.

LOW COST: HANDYPROBE

Connect the HANDYPROBE to the parallel printer port of the PC and start the software. Measuring can be carried out at once. The HANDYPROBE does not need external power supply. Some technical specifications:
0.5 ... 400 volt software select input range;
100,000 samples/sec.;
one input channel;
8 bits resolution (overall accuracy 2%).
A complete software program consisting of a digital storage oscilloscope, spectrum analyzer, voltmeter and a transient recorder is provided.
HANDYPROBE is very suitable for servicing and educational purposes.

US $ 169

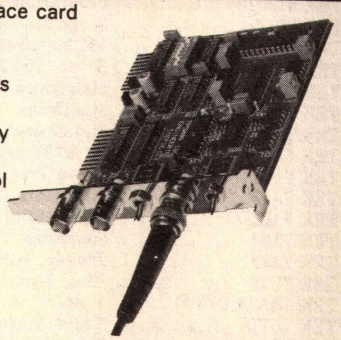
BEST PERFORMANCE: HANDYSCOPE

The HANDYSCOPE is connected to the parallel printer port. This makes it possible to carry out measurements with a laptop or notebook PC. Due to its high resolution (12 bits), the HANDYSCOPE is a very accurate unit. The measuring time is 100,000 samples/sec. Either of the two channels can be set independently over a range of 0.5 ... 20 volt (with a 1:10 probe up to 200 volt). The advanced software enables many measurements to be carried out. Two probes (switchable 1:1-1:10) are provided. The HANDYSCOPE is constructed as a small table model with two BNC connectors.
The length of the cable linking the PC and the HANDYSCOPE is 1.8 m, which can be extended to 3.8 m.

US $ 499

MULTIFUNCTIONAL: TP5008

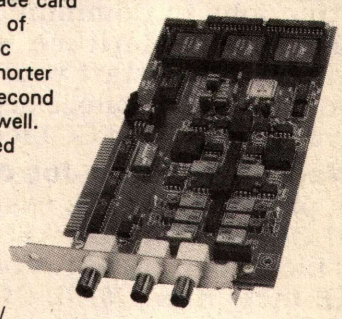
The TP5008 is an interface card that provides an analog output in addition to two input channels. This output in combination with the two inputs may be used for the setting up of a complete control loop. The output may also be used as a function generator.
The TP5008 has a resolution of 8 bits and a sampling rate of 200,000 samples/sec (200 KHz). The input range may be set to 0.5 ... 20 volt full scale deflection. The output range covers 1.25 or 2.5 volt. The TP5008 is fitted with BNC connectors and is delivered complete with a user manual and software.
Separately available are 1:1-1:10 probes and 1:100 oscilloscope probes.



US $ 307

VERY HIGH SPEED: TP208

The TP208 is an interface card with a measuring time of 2x20 Megasamples/sec (8 bits). Phenomena shorter than 1 millionth of a second can still be measured well.
The completely digitized triggering ensures very stable triggering with many trigger possibilities.
The TP208 has an input range of 5 mvolt/div .... 20 volt/div (12 steps) and an auto calibration function.
Since both channels may be sampled simultaneously, phase differences can be measured very accurately. Even single phenomena can be measured since each channel has a 32 KByte memory.
Comprehensive software is provided.



US $ 998

(Prices exclude applicable taxes)

Interested? Then call 1-800-626-6929 (toll-free) for a FREE demo diskette!

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20 character x 16 line capability. **$79.00** **2 for $149.00**

Mfr: Toshiba TLX-1013-EO.
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Alphanumeric—parallel interface

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40 x 4	$25.00	4 x 2	$5.00

5V power required • Built in C-MOS LCD driver & controller • Easy "Microprocessor" interface • 98 ASCII character generator • *Certain models are backlit, call for more info.*

Graphic and alphanumeric—serial interface

Size	Mfr.	Price
640 x 480	Epson	$50.00
640 x 400 *(backlit)*	Panasonic	$35.00
640 x 200	Toshiba	$19.00
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***LASER DIODE:* Sharp part#: LT022MC**
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Links 3270 mainframe systems to IBM PC

Proteon ProNet-4 Model p1347 Token Ring Board $79.00
16 bit • 4 Mbps • IEEE 802.2 and 802.5 compatible • twisted pair • interoperable with IBM Token Ring network

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ADAPTEC 4070A (RLL) OR 4000A (MFM) SCSI Controller, your choice $40.00

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Comes with pinout. 12V at 1.4 Amp input. Horizontal frequency 15 Khz. Ability to do 40 and 80 column.

5 inch Black & White.....$35.00
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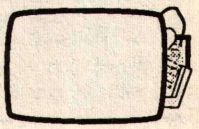

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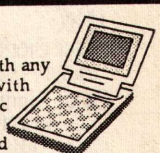
Portable Micro Terminal



Flip up LCD display (9-16 VDC) • Can communicate with any computer having RS 232 port • Can communicate with another Microterminal • Use by itself as electronic notebook • Onboard microprocessor, data RAM (32K) and Video RAM (64K) • Complex built in diagnostics and set up capabilities. • Original intention for POS applications. • display size 40x16 (256 x 128 pixels.) Dimensions: 6.3" W, 11"L, 2"H. (With LCD up height is 7.1")

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or 2 for $149.00

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Includes: • 286-12Mhz CPU (1 wait state) • Built in IDE & floppy controller • 80287 math coprocessor socket • FAST! on board SVGA with 256K RAM • 2 serial ports, 1 printer port, mouse port • EMS-LIM ver 4.0 memory & shadow RAM support • Up to 8 mb memory (256K or 1 Mb SIMMS) • Comes with 0K on board • On board speaker • REAL TIME CLOCK • Phoenix BIOS • Note: There is one long non standard bus connector on board

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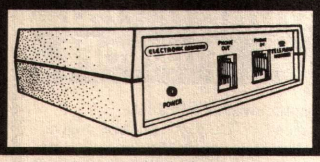
CIRCLE 275 ON FREE INFORMATION CARD

RAINBOW KITS

The Exciting New TELEPHONE MONITOR



Monitors your phone system, See how accurate your phone company really is!

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- Date & time of each call.
- Length of the call.
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2. RECORDS INCOMING CALLS :
- Date & time of call.
- How many times phone rings.
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3. RECORDS ANY DTMF TONE :
- Detects any tone on line sent by phone company or any other source.

Records to Screen or Floppy Disk

EASY TO INSTALL
- Connects to parallel port
- Phone line in.
- Phone line out to telephone.

All software included!

TM-1 ONLY **$99.95** KIT

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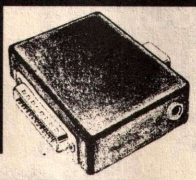
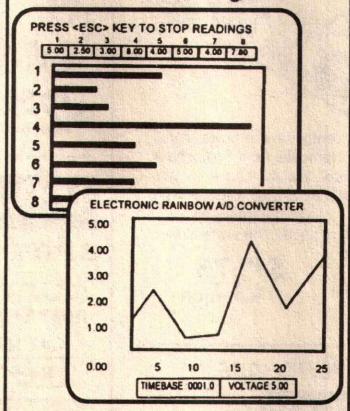
Complete with Software. Over 20 DOS programs provided!

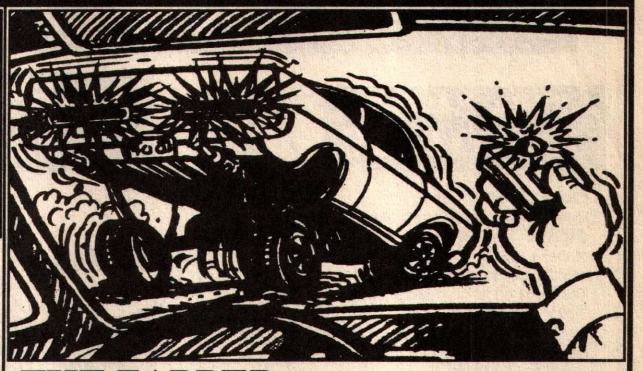




- Connect your computer to the outside world through a parallel port!
- Monitor eight sperate 8 bit analog inputs simultaneously and display them digitally or graphically.
- Use your computer as an oscilloscope using the provided DOS software!
- Hardware selectable 0-2.5 VDC or 0-5 VDC input range. Chart provided to calculate scaling resistors (resistors not included).

SIZE: 3"x2.5"x1" case. Mates to parallel port on back of PC.

AD-8 ONLY **$89.95**



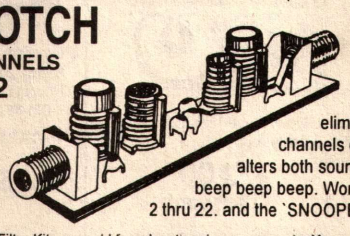
THE ZAPPER activates any radar detector within 3\4 of a mile. Check the brake lights of that sports car that just went by 90 miles an hour. Back off that 18 wheeler trying to eat your back bumper. Put the fun back in driving. THE ZAPPER is a 10GHz amateur transmitter the size of a cigarette pack, operates on a 9v battery, when the button is pushed, brake lights and radar detector light the skies. Complete with the rules of the new ROAD WARRIOR GAME...TROLLING FOR TAIL LIGHTS, Americas fastest growing highway participatory sport.

Built **$49.95**

Kit **$39.95**

TV NOTCH FILTERS

FOR CHANNELS 2 thru 22 ONLY



Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep beep beep. Works on cable channels 2 thru 22. and the `SNOOPER & BULLET.

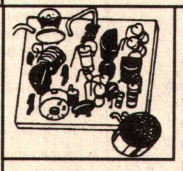
NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

DF-222 Kit **$14.95**

PHONE TRANSMITTER

Small but mighty,it fits anywhere. Phone line powered, never needs batteries. Transmits both sides of a phone conversation loud and clear, wireless, to any FM radio at great distances. Variable tunes from 70MHz to 130MHz FM. You can also use it as a speaker phone. SIZE .5"x1".

TEL-B1 **$12.95**



WIRELESS FM MICROPHONE

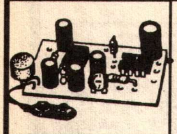
Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-1 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM , the frequency of any broadcast FM radio. Includes a mini-electret mike. SIZE: .8"x1" 6 to 12vDC

WM-1 **$14.95**

This Manual contains all schematics, parts lists & P.C. board layouts for all of the Rainbow Kits. Use your own parts to construct any of our kits.

KIT BOOK

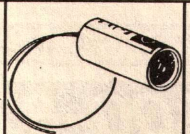
$14.95 **$9.95** with the purchase of any kit.



SUPER SNOOPER BIG EAR

Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. SIZE: 1"x.75" 6 to 12vDC.

AA-1 **$10.95**



5.0 mW Laser Diode

Great for making a gun sight, use as a transit, makes a super experimenters project. The beam is visible with a wavelength of 670 nm. Size of beam is 6mm at 5 meters. Operates on 3 volts DC at 85mA. Size: 10.5mm x 18.5mm with an adjustable collimating lens.

LDM-5 **$89.95**

4F

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JUMBO SAVINGS
JUMBO LEDS

Liton # LTL 327C - 8MM
Ideal for eye-catching indicators and displays. A recent quantity purchase of these BIG, 8mm diameter, red diffused LEDs enables us to provide some very special pricing. The leads on these devices have been trimmed to 0.325", leaving plenty of room for soldering. Normally these parts would sell for more than twice our price.

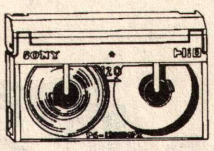
5 for $1.00

CAT # LED-23

100 for $15.00 • 1000 for $120.00

"HI-8" VIDEO CASSETTE (USED)

8 mm Video Camcorder Users!.

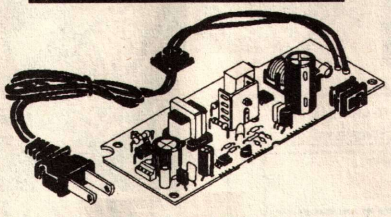


SONY Hi-8 T-120
Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased, each cassette has its own plastic storage box. New, these high quality cassettes sell for considerably more. Satisfaction Guaranteed.

CAT# VCU-8 **$3.00 each**

10 for $28.00 • 100 for $250.00

POWER SUPPLY BOARD

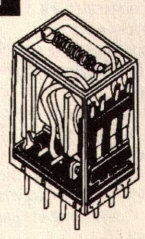


Working power supply, complete with power cord, fuse and on/off switch. Removed from Seikosha # SP-2400 dot matrix printer. We don't have the official specs on these, but they appear to have two outputs providing 5 and 24 vdc. Great for educational and experimental projects. The parts alone are well worth the price.
6.25" X 2.69" X 1. 45".

CAT# EX-76 **$3.75 each**

SPECIAL PURCHASE!!

4PDT RELAY



Omron# MYQ4-02-VH-6VDC.
6 Vdc, 37.5 ohm coil.
PC pins. 4PDT, 5 amp contacts.
1.07" X 0.82" X 1.41" high.

CAT# 4PRLY-6PC

$2.50 each

10 for $20.00

MINIATURE D.P.D.T. PUSH/ON PUSH/OFF

Augat/Alcoswitch # MPE206N
Miniature DPDT, push/on push/off switch. Splashproof: O-ring on shoulder and inside movable shaft provides moisture seal. Rated 6 amps @ 125 Vac. RED 0.4" diameter cap. 0.25" diameter threaded bushing. 0.8" behind panel depth. Solder lug terminals. UL and CSA listed.

CAT # MPB-20

$2.50 each **25 for $53.75 ($2.15 each)**

MINIATURE TOGGLE

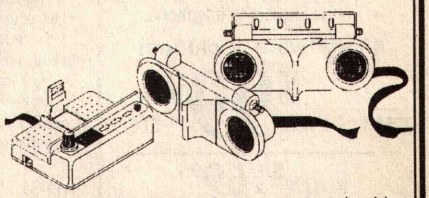
S.P.D.T. (ON-ON)
Right-angle, pc mount.
0.25" threaded bushing
Rated 5 amps @ 125 Vac.

75¢ each

CAT MTS-4RT

10 for $7.00 • 100 for $65.00

ULTRASONIC PROXIMITY DETECTOR



The ED-100 was designed for use as an auto/truck/RV back-up alarm. A digital display and audible beeper inside the vehicle inform the driver of the distance to impact beginning when the vehicle is within 14 feet of another object. Two 40 kHz ultrasonic emitter/detector modules, measuring 5.81" long X 1.9" wide, 2.05" thick, attach to the rear of the vehicle. The device operates on 12 or 24 Vdc.

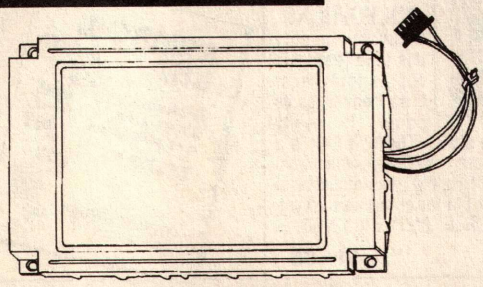
These units are new, in original cartons and include instructions. The company that marketed this device is no longer in business, and no manufacturer's guarantee is in effect. ***We offer these ultrasonic detectors for experimentation only and in no way wish to promote their usefulness as a driving aid.***
Originally sold for over $100.00.

CAT# ED-100 **$24.95 each**

640 X 480 DOT LCD DISPLAY

Sharp # LM64P70
Brand new 640 X 480 dot LCD flat panel display with on board high speed drivers and built-in CCFT backlight (inverter not included). Logic voltage: 5 Vdc.
LCD driver voltage: -16.2 Vdc.
Viewing area 6.8" X 5.1".
Overall module size: 10.1" X 6.23" X 0.33". These displays sold for over $300.00 new. Includes specs. and hook-up information.

CAT # LCD-17 **$45.00 each**



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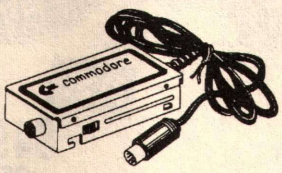
VIDEO/RF MODULATOR

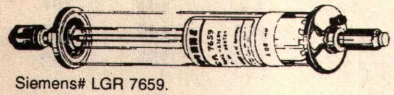


Originally made for use with the Commodore computer, these good quality video modulators were probably originally designed for 9 Vdc use, but they operate well on 6-12 Vdc. They accept color video and audio, and a selector switch is provided for output to channel 3 or 4. Easy to hook-up. Requires a 6-12 Vdc power supply or wall transformer and a connector to interface with your audio/video source. Output is an RCA jack. Hook-up instructions included. 3" X 1.47" X 0.75".

$5.00 EACH

CAT# AVMOD-3

LASER TUBE



Siemens# LGR 7659.
1 mW helium-neon laser tube. 22.5 mm diameter X 146 mm long. 1.7 mrad beam divergence.
7 kV start voltage.
1kV operating voltage.
3.5 mA current.

$25.00 EACH

CAT# LT-1

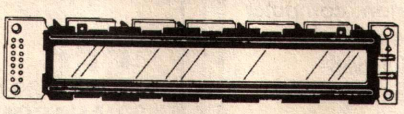
3" SPEAKER W/ BAFFLE

We don't know the original application for these speakers, but they're well made and will handle a lot more power than their size would indicate. According to our primitive tests they provide good mid range response at 30 watts or better. The well-constructed 3" 6 ohm speaker has a heavy magnet and a foam-edged paper cone. It's conservatively rated at 7 watts, but the 7" deep, fiberglass filled baffle enables it to sound good at much higher power. Give them a try for car or home applications.

$6.00 EACH

CAT # SK-31

40 CHARACTER X 2 LINE WITH EL BACKLIGHT



Optrex # PWB 40218-CEM-NY-EB
5 X 8 dot format. 0.23" characters. Display size: 6" X 0.67". Built-in drivers and controllers. Hook-up diagram included. Module size: 7.185" X 1.32". Inverter for electroluminescent backlight not included.

CAT # LCD-21

$16.00 EACH

SNAP-IN CAPACITORS

220 UF 250 Vdc

NICHICON CE 85º C PS (M)
1" diameter X 1.21"
0.4" lead spacing.

CAT# EC-2225

$1.00 EACH

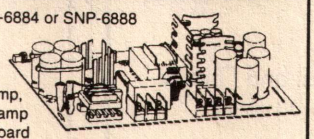
270 UF 200 Vdc

Sprague 81D 1" dia. X 1.42" high. 0.4" lead spacing.

CAT# EC-2720

$1.00 EACH

12 Vdc 5 Amp SWITCHING POWER SUPPLY



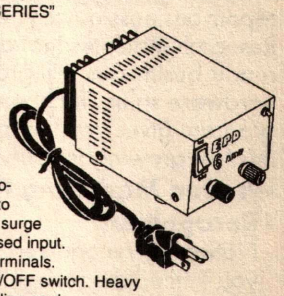
Skynet # SNP-6884 or SNP-6888
Input:
115/230 Vac
Output:
12 Vdc @ 5 amp,
-12 Vdc @ .3 amp
Small single board switching supply with fused input and adjustable output. 6 pin, snap-lock type header for output. 2 pin header for input.
5.5" X 3.15" X 1.45" high.

CAT # PS-1245

$8.50 EACH

13.8 VDC POWER SUPPLIES

M & G "PRO SERIES"



Regulated and filtered power supplies. Thermal overheating protection with auto reset. Short circuit protection with auto reset. Voltage surge protection. Fused input. Binding post terminals. Illuminated ON/OFF switch. Heavy duty grounded line cord.

Available in 3 sizes:

6 AMPS CONSTANT 8 AMPS SURGE

5.67" X 3.99" X 8.07". Weight, 5.95 lbs.

CAT# PS-128 $44.00 each

10 AMPS CONSTANT 12 AMP SURGE

5.67" X 3.94" X 9.06". Weight 9.26 lbs.

CAT# PS-1212 $64.00 each

20 AMP CONSTANT 22 AMPS SURGE

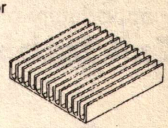
7.87" X 4.72" X 6.27". Amp meter on front panel. Weight 14.55 lbs.

CAT# PS-1222 $95.00 each

MICROPROCESSOR HEATSINK

Wakefield 1.5" square X 0.25" high black anodized aluminum heatsink for 15 X 15 PGA type chips. 13 vertical fins for maximum cooling efficiency.

CAT # HS-38



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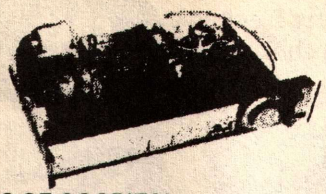
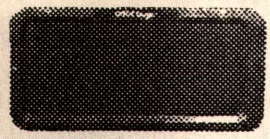
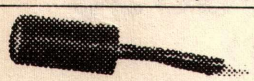


GOBS OF GOODIES!
Studioline Stereotrack II Cable TV Adapter
Separates stereo signals from the cable TV input, feeds TV signals to TV/VCR tuner and stereo signals to FM (either RF or fixed/variable level audio). Inside are hundreds of useful parts which may be removed for audio/RF projects. Controller board has CPU and socketed EPROM as well as Mitsumi varactor tuner. Cable/FM separator board. Regulated power supply sub-assembly. Channel-select board. Stereo separation output board. Black metal case, 14" x 10" x 3". Sold for experimental purposes only. With documentation. (92V020)
Two for $49.95

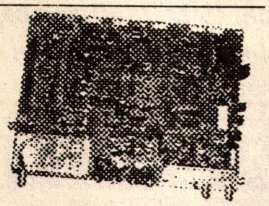
STAINLESS STEEL HARDWARE
Popular sizes used in electronic work. Assorted, may contain capscrews, Phillips, sizes 4-40 and up. (92Z005) **3 Lb. for $5.99**



2W, 9V SOLAR POWERED TRICKLE CHARGER
Approx 13.5" x 7" x 0.625". (94E013)
$24.95 each

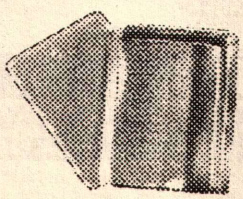


CADMIUM SULFIDE PHOTO CELL
0.25" x 0.5", with pigtails. (94L008)
$1.00 each

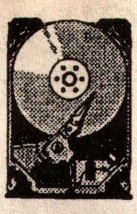


TVRO MOTHER-BOARD
These defective units contain many useful parts including a 950-1450MHz tuner, two NEC 5801 gain blocks, filters, etc. (92A008)
$24.95 each

ALUMINUM RF-TIGHT PROJECT BOX
Measures 2.25" x 3.25" x 1.5". includes lid.
(94U016) **79c**



RODIME 5180ST
134MB, SCSI, half height, formatted, used.
(94C020) **$119.00 each**



PRIAM 330MB SCSI DRIVE
Model 738 (94C017)
$199.00 each

10MB HARD DRIVE
MFM, half height, 5.25", used. (94C024)
$19.95 each

24-BIT 600-DPI COLOR SCANNER
Includes interface card, cabling, installation manuals, Interpreter 3.0 OCR software, Picture Publisher color image editing software and a TWAIN compliant driver. Windows compatible, one year factory warranty. (SF6C)
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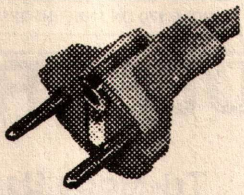

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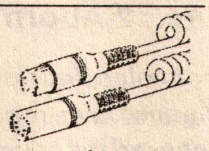
Black, 6 ft.long. (94W011) **$2.49 each**



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Used. (93C005) **$4.95 each**

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Erase and save $$$!

2708 (92I003)	**$ .25**
2716 (92I004)	**.75**
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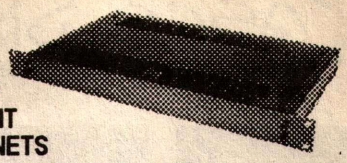
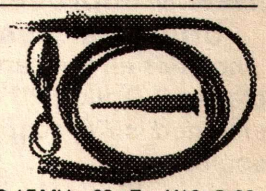
27512 (94I001)	**1.79**
27C010 (93I016)	**2.99**



RACK MOUNT CABINETS
These industry-standard 19" rack mount cabinets are made from 0.04" steel, with the front and rear panels being made from 0.06" aluminum for easier, custom fitting. These cabinets have been finished in gunmetal grey and come flat packed, ready for your final construction. These enclosures have die punched venting. Handles are furnished on all cabinets except RC3120A. These are sturdy, well-made, commercial quality cabinets and are sure to make your project look its best.

RC3120A - Front panel 19" x 1.6875" 1.5"H x 16.625"W x 9.625"D - **$38.00**
RC3120B - Front panel 19" x 3.4375" 1.5"H x 16.625"W x 9.625"D - **$46.00**
RC3120C - Front panel 19" x 3.4375" 3.25"H x 16.625"W x 13.1875"D - **$53.00**
RC3120D - Front panel 19"x 5.1875" 5"H x 16.625"W x 13.1875"D - **$58.00**
RC3120E - Front panel 19" x 5.1875" 5"H x 16.625"Wx 16.75"D - **$63.00**
RC3120H - Front panel 19" x 8.6875" 8.5"H x 16.625"W x 16.75"D - **$83.00**



SCOPE PROBE #1
Attenuation: X1 @ 15 MHz, 60 pF or X10 @ 60 MHz, 12 pF. Working voltage: 60VDC (including AC peak). Working temperature range: -13 deg. F (-25 deg. C) to 158 deg. F (70 deg. C). Compensation range: 15pF to 50pF. Avex model # 510-SW60S. (94Z001) **$19.50 each**

SCOPE PROBE #2
Attenuation: X1 @ 10 MHz, 75pF, X10 @ 100 MHz, 11pF. Working voltage: 600 VDC (including AC peak). Compensation range: 15-50 pF. Include 6" ground lead, spring hook, BNC adapter, I.C. tip, insulating tip, and trimmer tool. Avex model #510-SW-1. (94Z002)
$24.50 each

ULTRASONIC TRANSDUCER SET

MA40A5S and MA40A5R send-receive pair commonly used in ultrasonic motion detection. Spec sheet included. Sold only as a set.
(94P015) **$4.95/set**

AQUARIUM AIR PUMP
On soft rubber base, approx. 3"W x 4 1/4"L x 1 7/8"H. (94U020)
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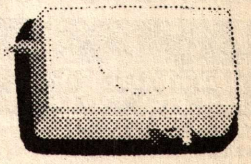

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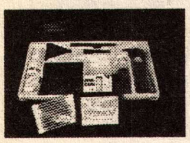
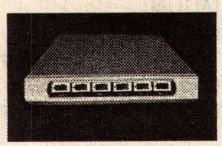
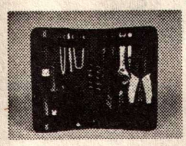


Computer Care Kit
5 1/4" disk #00648400 $14.70
3 1/2" disk #00648395 $14.70
Includes mini vacuum w/ 3 attachments, cleaning disk, head cleaning fluid, cleaning cloth, spray pump, cotton swabs & carrying case.

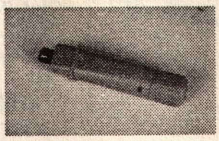


System Power Center
#01878805 $28.50
Protect your system from damaging power surges & spikes. Five power switches & master control switch. 15 AMP circuit breaker. 12"(W) x 13"(D)x 2"(H).

PC Pocket Reference
#12148430 $14.90
Handy reference book for the computer technician.Codes & numeric translation, video standards, keyboard scan codes, port pinouts and much more!



Deluxe 22 Piece Tool Kit
#06248325 $33.80 (above)
Zippered carrying case includes diagonal pliers, crimper, soldering iron, screwdrivers/nutdrivers, tweezers & more. Call for more details.
Economy 11 Piece Tool Kit
05947245 $10.90



Deluxe Punch Down Tool
#04647595 $36.80 (above)
Adjustable pressure regulator with stow compartment
Economical Punch Down Tool
#04648255 $9.75
Reversable Blades
$9.65
Straight blade for 66, 110/88, modular type

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Cut-Strip-Crimp- all in one! Handset plugs (4 pin),RJ11/12 (4 & 6 pin), DEC/MG offset (6 pin) RJ45 (8 pin) & 10 pin plugs. Cushioned hand grips. Tough steel construction
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Simcheck Memory Tester
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Identifies bad memory chips. Easy to use. Tests all SIMM & SIP memory modules 64Kx8/x9, 256Kx8/x9, 2Mx8, 4Mx8/x9, 16Mx8/x9. LCD display. AC adapter.

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MICRO TV CAMERA WITH TRANSMITTER

As small as a package of cigarettes ! Complete TV camera with transmitter. Available on VHF channels 7-13 or UHF channels 14-29. Crystal controlled models also available. Operates up to 4 hours on 9V battery or may be used with a wall adapter for permanent installation. Range approx. 100 yards. Perfect for any surveillance application !

CAMERA WITH TRANSMITTER SEMI-KIT UP402 $399.00 PLUS S&H

Please call for custom configurations.

VIDEO TRANSMITTER KITS

VARIABLE FREQUENCY MICRO TV TRANSMITTER

Similar to our crystal controlled unit but with a variable frequency oscillator permitting its output to be placed on either VHF channels 7-13 or UHF channels 14-29. Range approximately 100 yards. May be used with any composite video source such as a camcorder.

M200 PCBOARD $14.95 M300 KIT $49.95
M301 SEMI-KIT $99.95 PLUS S&H

XTAL CONTROLLED MICRO TV XMTR

A perfect companion to our Micro TV Camera but will also work with any video source. Xtal controlled. Available on VHF channels 7 to 13. Draws 20 ma. from a 9V supply. May also be used with a wall adapter. Range approximately 100 yards.

SEMI-KIT UPX301 $139.95
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HIGHER POWER VARIABLE FREQUENCY MICRO TV TRANSMITTER

Similar to our other variable frequency TV transmitter but with a buffer stage for higher power output and improved stability. When used in combination with our Micro TV Camera makes a self contained unit small enough to fit into a package of cigarettes.

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Linemans rubber insulating gloves. These 14" class II gloves meet the ASTM D120 requirements. Black outside, bright color inside so snags will show up clearly. These gloves are a must for anyone working with voltage, chemicals, or stuff you just don't want to touch with your bare hands. Thick, thick, thick rubber gloves rated at 20KV test volts and 17KV use voltage. Compare at $77.00 a pair.

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We bought a large quantity of 2708s, 2716s, 2532s, 2732s, 2764s, 27128s, 27256s and 27512s from a computer manufacturer who redesigned their boards. We removed them from sockets, erased and verified them; and, now we offer the savings to you. Complete satisfaction guaranteed.

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2532	2.00	10/17.50
2732	2.00	10/17.50
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EEPROM

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SSI-202 Decoder.....$2.25
8870 Decoder.....$2.25
5089 Generator.....$1.25
M957 Receiver.....$2.25
M980 Trim Leads.....$2.00
Data $.50 each

LAMP STRING

Incandescent Lamp String 8-14v 85 ma minature lamps Easily separated, can be left in string for 115v operation. Great for model railroads, dollhouses, etc.

$1.25

LINE CORD

6 FT. 3 wire (16/3) Line Cord
IEC on one end
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GREAT COMPUTER CORD
$1.59

1 FT. IEC Female to IEC Male. From monitor to power supply.

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For Microprocessor Application
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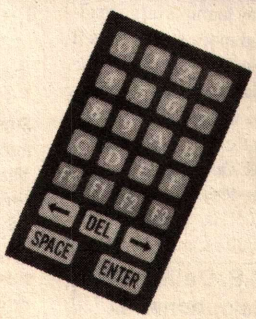

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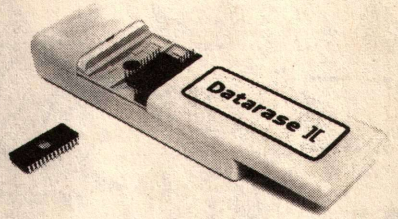
UV ERASER

THE ULTIMATE PERSONAL **UV ERASER**

The DII Has a 2-8 minute internal timer with time out beeper. Six month unconditional guarantee. Complete documentation.



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- Molded Plastic Case
- Shirt Pocket Size
- Auto Start
- Regulated lamp output for uniform erase time
- Erases most EPROM's/EPLD's in 3 minutes
- Handles all sizes up to four at a time

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Image device-1/3" CCD image sensor
Power requirements 6-12VDC
Resolution 400 HOR. X 350 VERT.
Dimensions 1-1/2"(W)x1-7/8"(H)x1"(D)
Works excellent in the infrared range
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Very low light <1 lux (f 1.6)
Output NTSC (1.0v p-p) RCA composite

$149.00

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OP290C - 150 MA Max. E_R (APT) 26 MW/CM² 100 MA T 1-3/4 E_R(APT) 300MW/CM² 1.5A pulsed; wide beam. **3/$1.00**

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SOLID STATE TIME DELAY RELAY

Operates from 12VDC. VERY accurate and repeatable. Delays from 1 second to approx. 30 minutes. Output is a SPDT relay with 5 Amp contacts. Complete kit with documentation. Board is 2" x 3½"

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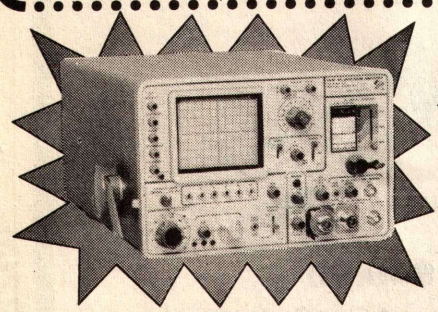
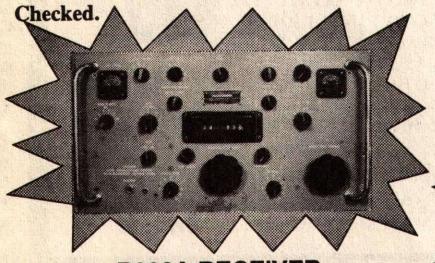


INDUSTRY STANDARD TEKTRONIX 491 SPECTRUM ANALYZER

Covers 10 Mhz - 40 Ghz. Solid state portable unit features internal phase lock, minimum sensitivity is - 100 dBm. A 12.4 Ghz mixer is included with each unit. External mixer kit (40 Ghz) and attenuators are available with purchase of each 491 for $400.00 extra per set. **Price: $1,200.00 ea. Checked.**



R390A RECEIVER

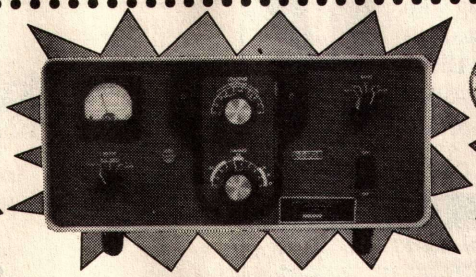
"The **CLASSIC RADIO RECEIVER** that is still a great investment". - These units are complete with ***orig. meters*** and cover the frequency range of 0.5 - 32 Mhz in AM, CW, MCW with direct frequency readout via mechanical digital display -physically complete, less covers.

Price: $195.00 Used Repairable

BECKMAN INDUSTRIAL PROG-POWER SUPPLIES PPS 300 / PPS 600

Either digital high performance power supply operates in any no. of modes e.g.:Man, Delta V, Delta T, Remote, CC, CV, Progammable via IEEE-488 or keyboard entry. Output power for the PPS-300 is 40 VDC @7.5A and PPS-600 is 60 VDC @10.0A. These units are new in original carton and come with instruction book.

Price:PPS-300 $750.00 PPS-600 $1100.00



COLLINS 30L-1 POWER AMPLIFIER

One of the finest mid-size linear amplifiers ever produced specifically for the Premier Ham Radio Operator. It covers the 80,40,20,15 and 10 meter bands in either SSB, CW, RTTY or SSTV modes. Input drive power is 70-100 watts for full output. Power input is 1200watts, @ 115/230 vac 60 Hz. **Output power** is 650 watts RF (1000w @ reduced duty cycle).

These units are in **exceptional** condition complete with cables and connectors. If your looking for the amp opportunity of a life time, you've just checked-in!!!

Price: $695.00 round emblem.

RACAL RECEIVER RA 6790/GM

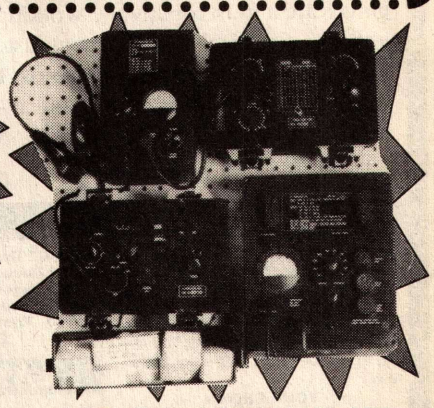
Superior quality and design are standard in this 500Khz-30Mhz general coverage receiver. Modes of operation are AM,FM, CW,U/LSB,ISB -optional, with room for seven bandpass filters. The illuminated LCD display features large readable digits for frequency and mode status as well as AF or RF signal strength.Tuning can be directly entered via keypad or with a tuning knob. Three different gain modes are Manual, Automatic, and Automatic with selectable threshold. Fully Checked & Operational.

Price: $995.00 Radio only-less filters.

Bandpass Filters: 400Hz/1.2KHz/2Khz/6.8KHz 16Khz/USB/LSB are **$65.00 ea.** max 4 per unit.

All Prices in U.S. Dollars
Please include telephone/fax number with mail-in orders.
Orders must be prepaid by guaranteed instrument.

Manuals available at extra cost

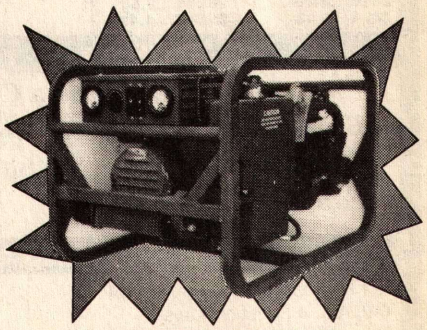


SPECIAL FORCES RADIO SET R-1004/GRC-109 T-784/GRC-109

"Its a dream come true."Complete GRC-109 radio sets including all the goodies as follows:

- R-1004/GRC-109 Receiver
- T-784/GRC-109 Transmitter
- PP-2684/GRC-109 Power supply (AC,DC)
- PP-2685/GRC-109 Power supply (AC only)
- CN-590/GRC-109 Voltage regulator (For hand crank generator)
- Plus Headset, Accessory kit with new spare tubes and parts, original manual and cables.

These are new in the box. A ***FABULOUS*** collector item!! **Price : $350.00 Complete sets only.**



MILITARY STANDARD D.C. GENERATOR

Superior QUALITY plus rugged design are features of this deluxe 2 cylinder gasoline generator. The control panel contains meters for voltage & current indication , main circuit breaker and voltage adjustment.Shielded wires and plugs comprise the RFI suppression ignition system eliminating most radio noise. These units are "**new**" in the original carton complete with operators manual and only require fuel and oil for operation, output voltage is adjustable approx 10-32v (28v) nominal @ 53.3 amps (1.5Kw) continuous load.

Price: $295.00 New in Original Carton

Weight =121 lbs. Dim=L 27"xH 18"xW 20"

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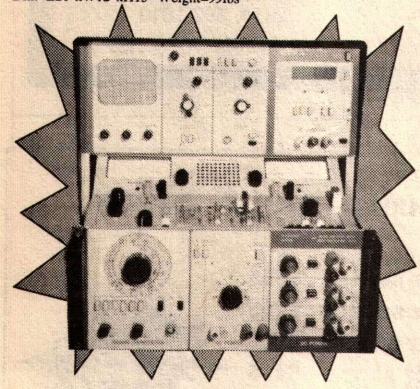
STATIC FREQUENCY CONVERTER

Finally a simple way to power up all that 400 cycle stuff. This is a completely self contained solid state converter that just plugs in to any 115vac 60 Hz power source and provides easy instant 400Hz single phase 115vac output @500 watts. **Price: $595.00 ea. New in Original Carton**
Dim=L21"xW12"xH15" Weight=99lbs



NIDA ELECTRONIC TRAINER

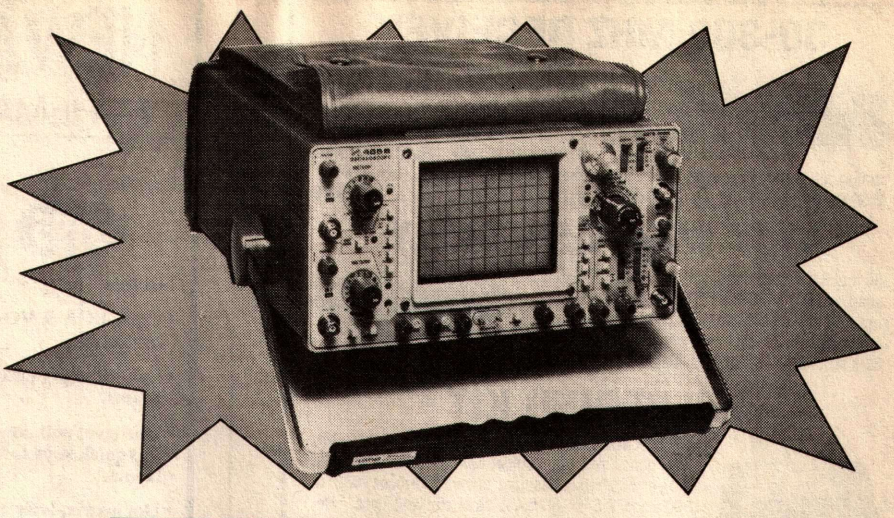
For those of you with limited funds this system provides you with the most essential instruments in one system. It incorporates the following:

- -10MHz oscilloscope
- -Autoranging DVM
- -Function generator
- -"3" variable dc power supplys
- -"1" variable ac power source
- -Precision decade resistance
- -Speaker and 2 analog meters

This unit comes complete with a number of electronic experiments assembled on easy to use plug-in cards. **Price: $365.00**

Just Arrived-

New stock of ***high end*** Harris, Rockwell-Collins and Racal communications equipment. Call for more information and availability.

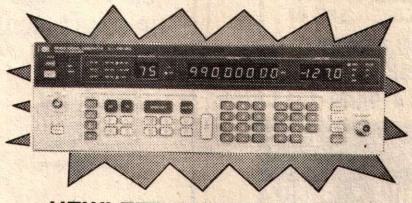


TEKTRONIX 465B

Proof is in the pudding when it comes to this instrument's track record. There's no doubt, that popularity speaks many languages when speaking of the "465B". This excellent instrument continues the tradition of the standard 465 oscilloscope by adding useful features such as CH-1, CH-2 sum or difference, trigger view in any combination, alternate sweep and trace selection versatility. Many technicians dream of owning a quality 100-MHz oscilloscope, but funding rairly permits. Fortunatcly, we were recently able to aquire a limited supply of 465B-s in nearly *new* condition. Our LOW PRICES will likely permit "you" to own one of the best scopes anywhere in the country. If your needs are current and action *swift* you too will be a member of a growing club!!!

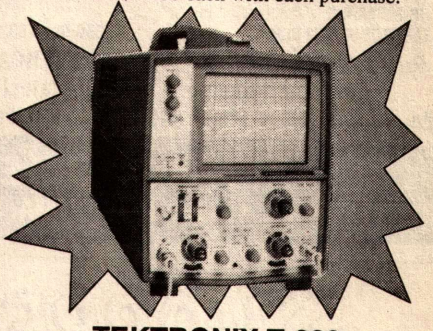
SELECTED EXCELLENT COND.....$849.00
VERY GOOD CONDITION.....$695.00

These instruments are fully checked out and calibrated. They are supplied with an original front panel cover and complete service manual. Original TEK Probes are $75.00 each with each purchase.



HEWLETT PACKARD 8656B SYNTHESIZED SIGNAL GENERATOR

This Generator operates from .1Mhz-990Mhz. Modulation is AM or FM with int. 400Hz/1KHz modulation. This unit contains a high performance ovenized oscillator OPT 001, HPIB interface and OPT 002 rear panel output. High-performance and economy make this a great investment. The units are "NEW" never used, still factory sealed. manuals available.
Price: $5995.00 New.



TEKTRONIX T-922 15 MHz OSCILLOSCOPE

Recommended as an excellent starter scope or for those on a tight budget but with an appreciation for quality test gear in their lab. This rugged little scope features 2 input channels T.V.. trig, bright large CRT and X,Y capability. Unit is shipped fully checked out and ready to go. **Price: $269.00**

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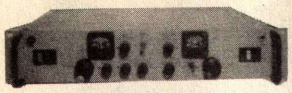

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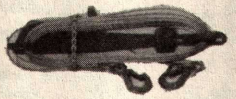

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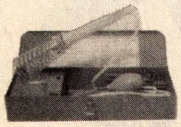

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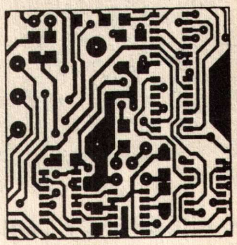

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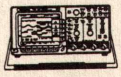

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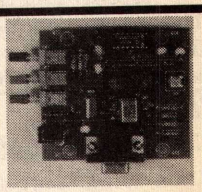

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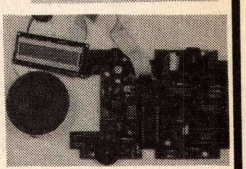

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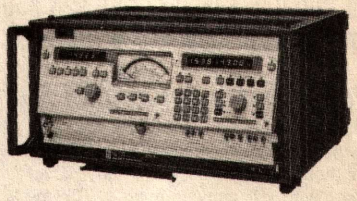

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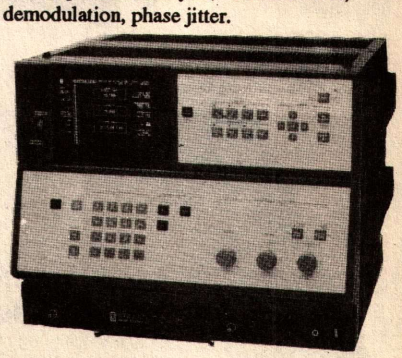

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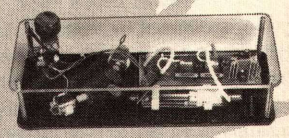

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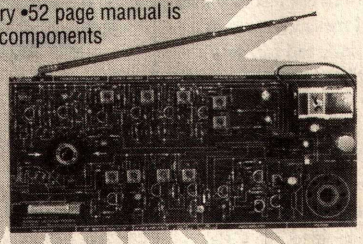

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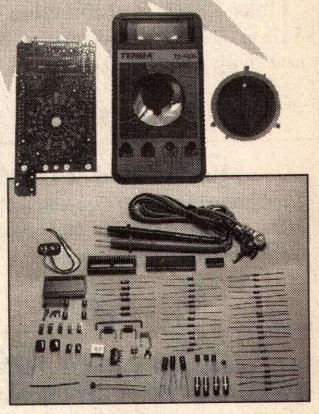

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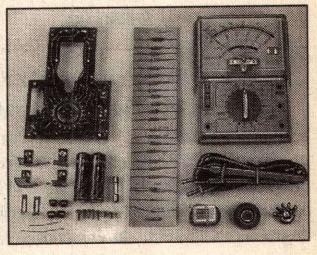

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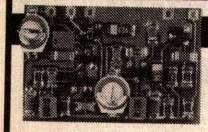

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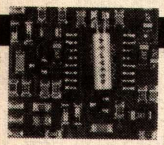

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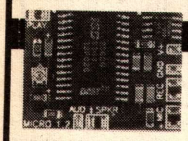

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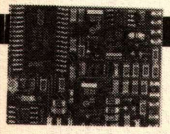

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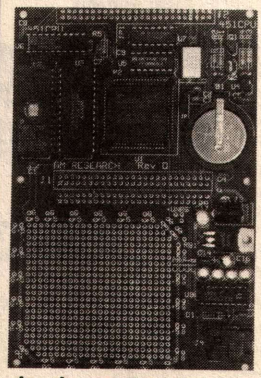

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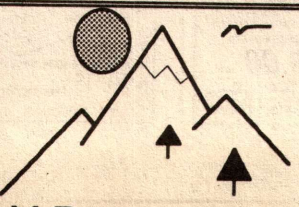

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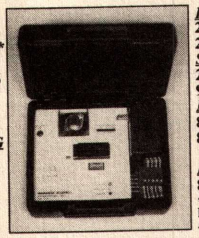

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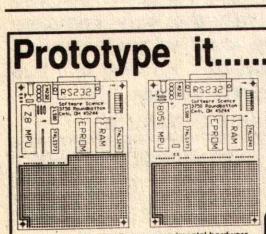

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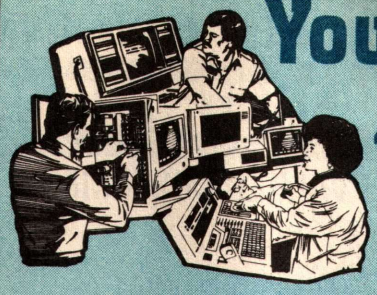

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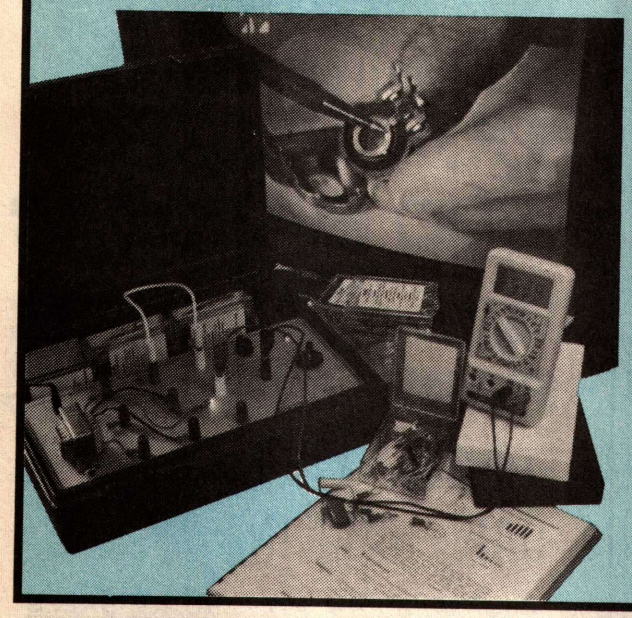

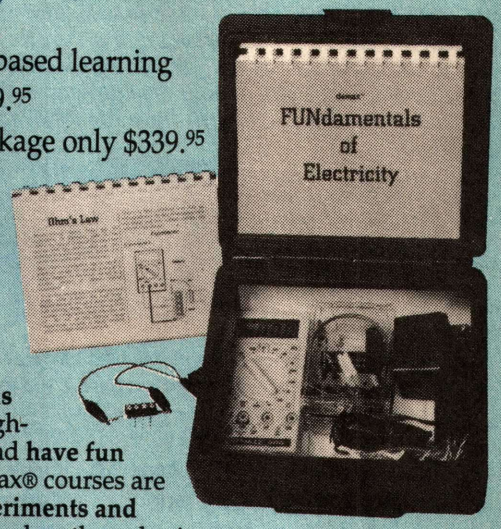

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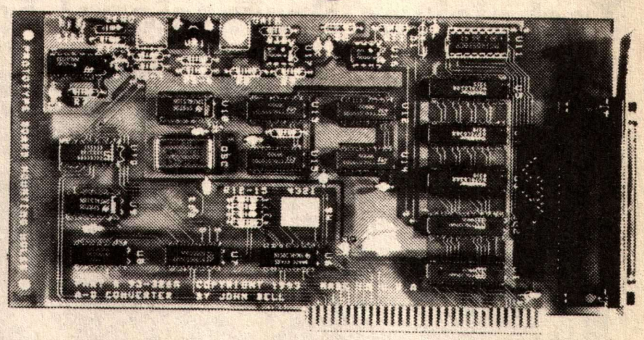

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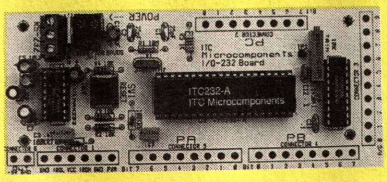

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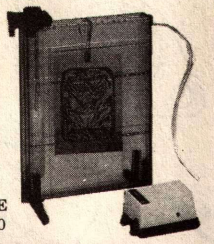

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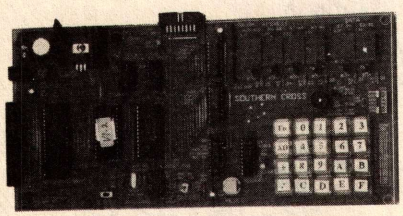

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The Southern Cross SBC is designed to teach beginners modern code development techniques as well as assembly language. Start with machine language using the on-board 21 hex digit keypad, then progress to using a PC Assembler provided with many program examples. Serial download assembled program from PC to Southern Cross. Serial interface provided.

Simple, but powerful monitor program fully annotated. Learn to use parts of it in your own programs by 'system calls' & using a 'header file'

Learn how to single step through your program to find errors. Both hardware & software single stepping provided & explained.

We do not fill the User Manual with pages of theory. Go straight to program examples. Starts from a very basic level anyone can follow.

The Southern Cross system includes:

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- Hardware speed control
- 8K EPROM
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- 4.00MHz Z80
- 10 year RAM backup with optional DS1213B
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- 9-15V AC/DC Single-sided PCB 9.75" x 5.15"

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SC3EN Relay Board-1 relay **$27.00**

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DS1213BEN SmartSocket **$18.00**

DS1216BEN SmartWatch **$36.00**

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Basic low cost counter. Two or more counter modules may be plugged together with 6-pin sockets & harness provided. Uses a single-unit 3-digit LED display. Built around the 14553 & 14551 chips. Box & battery provided. The separate COUNTER MODULE shows how to use the Kit as a counter. Has COUNT & RESET switches with debounce circuit built in to eliminate problems from noisy switches. 9V battery operation.

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Most ICs operate in the 4V to 40V range. The LM3909 from National Semiconductor changed this. Two PCBs supplied. A 1.5V D cell will flash an LED for over two years. Use as an imitation car alarm. A second PCB connects the chip as a 1.5V continuity tester. Seven pages of documentation provided from National Semiconductor.

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General Purpose 4-1/2 Digit Counter uses Harris 7224 IC. Full instructions INCLUDING the 7224 data sheet is included. All pins from the 7224 are brought out for easy access. Directly drives an LCD (provided). This project is a building block that you can use as part of a larger project. The LCD section can be cut away and connected by a flat ribbon cable. The Kit has its own 5V regulated supply on board for the 7224, allowing a relatively wide range of voltage inputs from +6V to 10V. The Harris 7224 counts up to 15MHz, guaranteed, 25MHz typical.

CAT NO KIT 36EN — PRICE $42.00

Intro to Microcontrollers

Learn to program microcontrollers without going to technical college. This Kit introduces the Motorola 68HC705K1, an 8 bit, 16-pin microcontroller released in 1992. The Kit is a down counter from 60 or 90 seconds with beeps every 10 seconds. All the software code is supplied and fully explained. See how easy it is to change the time and beep settings by simple changes in the software program. You can judge for yourself how using micro-controllers is a huge advance over using logic ICs. On/off switch and pulldown resistors on input lines are all built into the K1 and are under software control. 9V battery powered.

All the information about how to continue learning to program these "computers-on-a-chip" is supplied. The tools to program the K1 are available at very low cost (under $200) from Motorola. The K1 is the simplest 8-bit microcontroller available.

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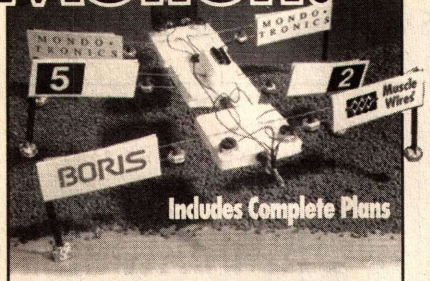

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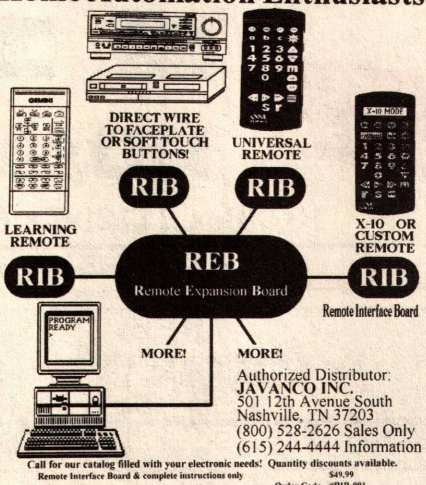

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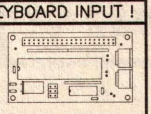

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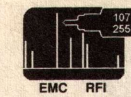

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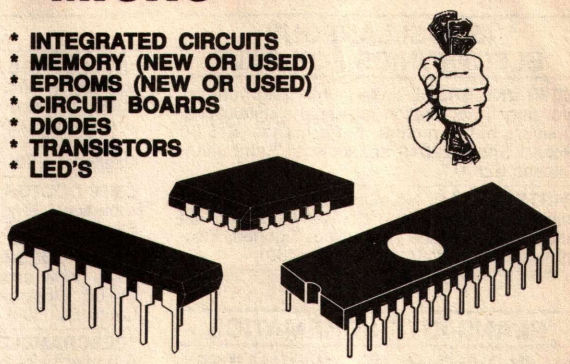

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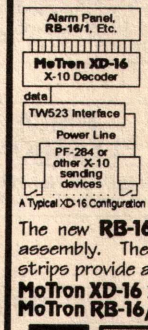
XD-16 X-10 Decoder & RB-16/1 Relay Board



A Typical XD-16 Configuration

The new **XD-16**, when connected to the required TW523 power line data interface module, decodes all 256 X-10 codes sent by PF284, or similar, X-10 senders. The house code is DIP switch selectable. The 16 open-collector outputs are turned on or off as unit and command codes are decoded. The XD-16 may be used to drive relays, LEDs, etc. in custom alarm or house control applications. The **XD-16** is a 3" x 3" printed circuit board . Requires 9-18 VDC @ 25ma. (12 VDC @ 500ma recommended when powering the **RB-16/1**).

The new **RB-16/1** Relay Board is a 2.75" x 6" printed circuit board assembly. The board features 16 relays (SPDT, 1A). Three terminal strips provide access to relay connections. Requires 12 VDC @ 450ma.

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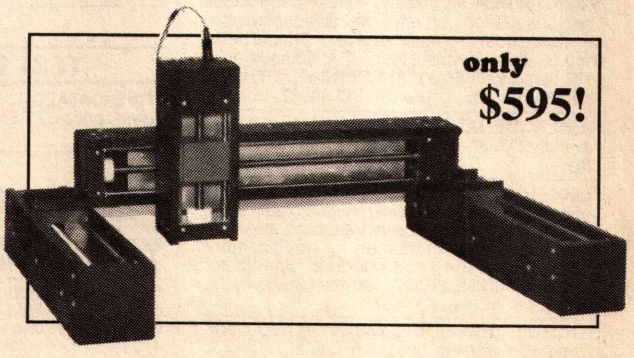

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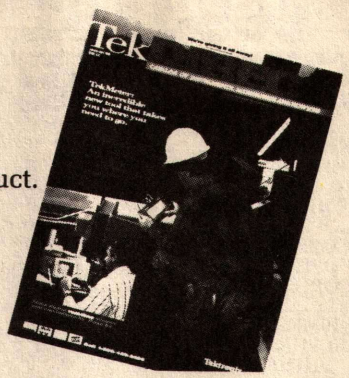

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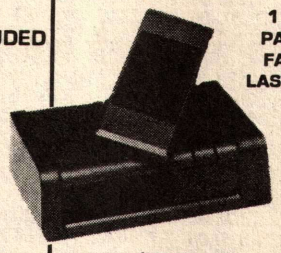

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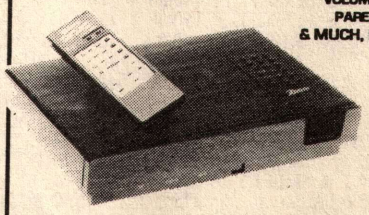

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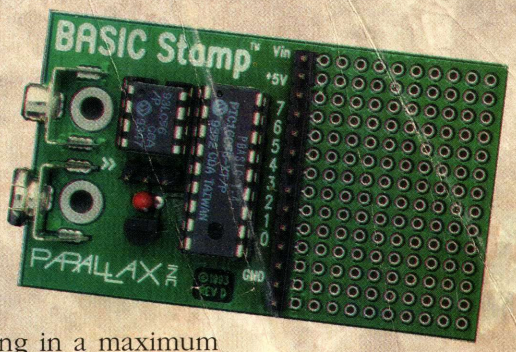

The BASIC Stamp is a small single-board computer that runs BASIC programs. It has 8 I/O lines, which can be used for a variety of digital and analog purposes. The Stamp's BASIC language includes familiar instructions, such as GOTO, FOR...NEXT, and IF...THEN, as well as SBC instructions, such as SERIN, PWM, and BUTTON. Each instruction takes 2-3 bytes of the Stamp's 256-byte EEPROM, resulting in a maximum program size of 80-100 instructions. Programs execute at about 2,000 instructions per second.

The BASIC Stamp Programming Package contains everything you need to program Stamps using your PC. The package includes our editor software, programming cable, manual, application notes, and free technical support. **The package is available for $99; Stamps are sold separately for $39.**

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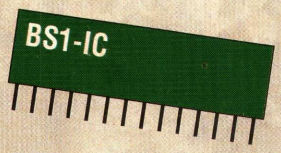
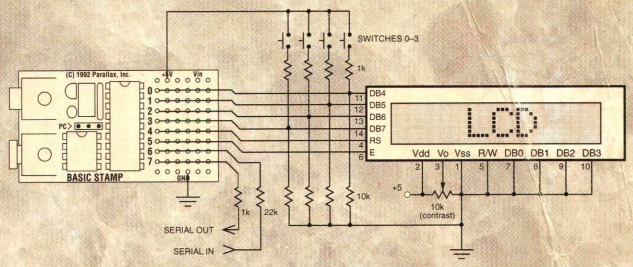


New Stamp Module Available Soon

A number of customers have expressed interest in a SIP-type Stamp for use in their products. So, we designed the "BS1-IC" depicted above (actual size). The BS1-IC has the same functions as the original Stamp, but without the prototype area and battery clips. We should have production units in November, depending upon availability of surface-mount parts. **Pricing will start at $29.**

Micro-Terminal

In this application, the Stamp receives serial data and displays it on the LCD. The state of the four buttons is then transmitted serially.



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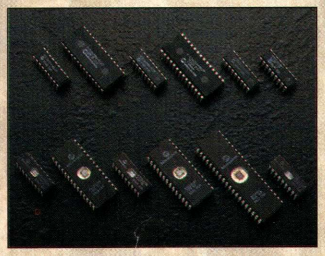

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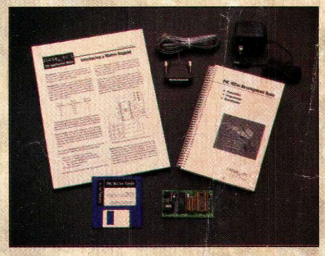

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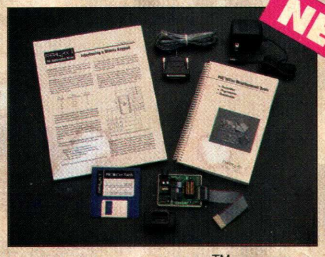

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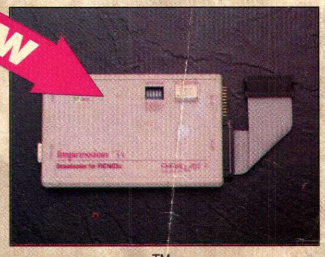

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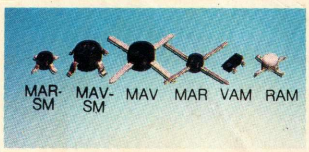

Models above shown actual size

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add suffix SM to model no. (ex. MAR-1SM)	MAR-1 1.04	MAR-2 1.40	MAR-3 1.50	MAR-4 1.60	MAR-6 1.34	MAR-7 1.80	MAR-8 1.75	
	MAV-1 1.15	+MAV-2 1.45	+MAV-3 1.55	MAV-4 1.65				MAV-11 2.15
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Gain, dB at 100MHz	18.5	12.5	12.5	8.3	20	13.5	32.5	12.7
Output Pwr. +dBm	1.5	4.5	10.0	12.5	2.0	5.5	12.5	17.5
NF, dB	5.5	6.5	6.0	6.5	3.0	5.0	3.3	3.6

Notes: + Frequency range DC-1500MHz ++ Gain 1/2 dB less than shown

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40 AMPLIFIERS* 10 MAR-1, 10 MAR-3, 10 MAR-4, 10 MAR-8
150 CAPACITORS* 50 100 pf, 50 1,000 pf, 50 10,000 pf
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*values or models may be substituted without notice, depending on supplies.

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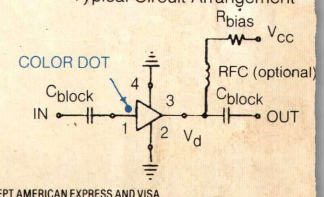

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